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A GUIDE

TO THE

FOSSIL MAMMALS AND BIRDS

IN THE DEPARTMENT OF

GEOLOGY AND PALÆONTOLOGY

IN THE

BRITISH MUSEUM (NATURAL HISTORY),

CROMWELL ROAD, LONDON, S.W.

WITH 6 PLATES AND 88 TEXT-FIGURES.

NINTH EDITION.

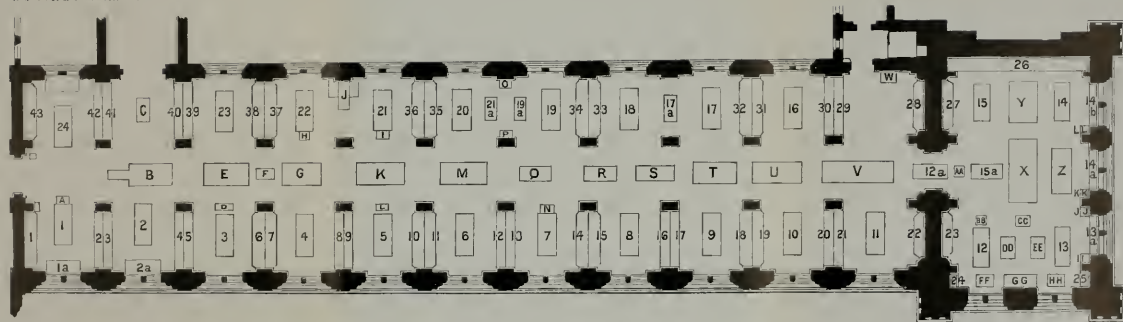
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PLAN OF THE GALLERIES OF FOSSIL MAMMALS AND BIRDS.

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(To face Title-page.)

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P R E F A C E.

THIS ninth edition of the "Guide to Fossil Mammals and Birds" differs very little from the eighth, which was entirely re-written in 1904. It still remains merely a Guide, and is not in any sense a systematic treatise. As fossils can only be understood by those who have some acquaintance with the existing world of life, it assumes on the part of the reader at least as much elementary knowledge as is contained in the Guides to the Department of Zoology. Its arrangement is determined by that of the cases and specimens, and it sometimes refers to trivial details which are of interest solely to visitors actually in the Galleries.

Many of the specimens bear small discs of green or red paper. Those marked with green discs are either "type-specimens," or have been described and illustrated in some scientific work, to which a reference is given on the label. Those marked with red discs have been merely noticed or briefly described in print.

A. SMITH WOODWARD,

Keeper of Geology.

February, 1909.

INTRODUCTION.

OBJECTS much resembling fishes, shells, plants, and other remains of living things, have been noticed in rocks from time immemorial. They are so abundant and conspicuous in some of the countries round the Mediterranean, where the Greek and Roman civilisations flourished, that they cannot fail to have attracted the attention of the earliest observers. Herodotus, for example, referred to sea-shells from the stone quarries in the hills of Egypt and the Libyan desert. Other contemporary philosophers and writers made similar observations, and most of them appear to have reached the very natural conclusion, that these petrified relics were originally buried in the bed of the sea, which had hardened and become dry land through the retreat of the waters.

At this early period in the study of natural philosophy, however, it was a common belief that animals could originate from the mud or slime of lakes and rivers. There was therefore another reasonable explanation of their occurrence as petrifications in stone which seemed simpler, because it did not involve any startling theories as to great changes in the relations of land and sea. If certain animals could be generated in mud, it appeared quite probable that they should sometimes remain concealed in their native element without reaching the surface, and in that case they would become hardened into stone itself. As Theophrastus remarked concerning petrified fishes, they might have "either developed from fresh spawn left behind in the earth, or gone astray from rivers or the sea into cavities of the earth, where they had become petrified." These bodies thus appeared to be mere curiosities, and they were treated as such by Aristotle,

who was content to regard them as produced by some plastic force in the rock which he could not explain.

The authoritative opinion of Aristotle was almost universally accepted by the few writers who considered the subject before the revival of learning towards the beginning of the sixteenth century. By this time the numerous shells, teeth, and fish-remains met with in the stone quarries of Italy had induced several observers in that country to reconsider the question of their true nature. Similar discoveries in other European countries were also being discussed in their bearing on the same problem. The objects found in stone were now closely compared with the shells, teeth, and skeletons of the animals most nearly resembling them which still lived in the Mediterranean sea. The plant-remains were also studied deeply in connection with the leaves of the known existing vegetation. The result was that, although many observers still adhered to the long-prevalent belief, some of the most philosophical minds were compelled by strict reasoning to admit that the *fossilia* (Latin, "things dug up"), or fossils, as they were now commonly termed, were really the remains of the once-living animals and plants which they appeared to represent. Leonardo da Vinci, the well-known painter, was one of the first to support this opinion with unanswerable arguments; while Steno, a Professor in the University of Padua, more than a century later, made it impossible any longer to doubt his demonstration of the facts. Steno's collection was acquired by the English Gresham Professor, John Woodward, who bequeathed it to the University of Cambridge, where it is still preserved in the Woodwardian Museum.

The true nature of fossils was thus settled by the beginning of the eighteenth century and the next problem was to explain how the remains of sea-animals had been buried in the rocks far inland and at great heights among hills and mountains. For at least sixty years it was the prevailing opinion that all the phenomena could be accounted for by the Deluge recorded in the Pentateuch. There were, however, many difficulties in accepting this explanation, and the discussions at the time led to a most detailed study of the manner in which the fossils were grouped and distributed in the different kinds of rock. Observations accumulated at a remarkable rate, until, by the end of the eighteenth century, it became quite clear that the fossilised animals and plants could not have lived all together at one

time, but belonged to many different periods of the earth's history. Their destruction and burial, therefore, could not be ascribed to any single great catastrophe. It was demonstrated that during past ages the distribution of land and sea, mountains and plains, had frequently changed—that, in fact, rain, rivers, waves, currents, volcanoes, and phenomena like earthquakes, were continually altering the earth's surface, even under the eyes of man himself. The fossils were proved in most cases to be buried in displaced portions of sea-bottom, and in the mud of dried-up lakes; and it was realised that the relative ages of these deposits could be determined by the order in which they lay one upon another. Thus arose the true "science of the earth," which was named **Geology** by De Lue in 1778.

An English civil engineer, William Smith (1769–1839), was perhaps the first to realise fully the possibilities of this new branch of learning. His profession necessitated much travel through the country, and his interest in the distribution of fossils in the different kinds of rock led him to make a large collection, which was acquired by the British Museum in 1816, and is now exhibited in Gallery No. 11 of the Department of Geology. His published maps and writings prove that the various features of the landscape, in districts where fossils occur, are naturally carved out of layers of rock, which are simply old sea-beds or lake-beds piled one upon another, the oldest at the bottom, the newest at the top, each containing its own definite and invariable set of fossils. They also show that in most cases when these old sediments were raised into dry land, they were tilted in various ways from their originally horizontal position; so that it is often possible in a short walk to pass over the out edges of many successive layers, perhaps hundreds of feet in thickness, representing immense periods of time.

While Smith and others were busily engaged in collecting fossils and observing their distribution, Blumenbach, Cuvier, Lamarck, Brongniart, and other naturalists were occupied with a detailed study of the fossils themselves. They soon demonstrated that, while most of these petrified remains could be interpreted by comparing them with the life of the present world, a large proportion represented animals and plants no longer existing. They also observed that the older the fossils, the more strikingly different they were from any animals and plants now living. It therefore became evident that fossils afforded a means of discovering

the past history of life on the earth—of determining the gradual stages by which our present animals and plants have become what they are, and have assumed their present geographical distribution. Thus was attained the “science of ancient life,” which was named **Palæontology** by H. D. de Blainville and Fischer von Waldheim in 1834.

The Department of Geology in the British Museum chiefly deals with fossils from the latter point of view, and attempts to explain the main features in the life of the Present by reference to that of the Past.

Note to the Geological Time-scale.—The names in the three columns to the left are applied only to periods of time. The names in the two columns on the right are those of actual strata deposited during the time-periods opposite which they are placed. These strata or rock-groups are only a few out of the many that might have been mentioned, and it must not be inferred that those in the European column are the precise equivalents of those next them in the British column. It is just because rock-formations in different parts of the world so rarely are equivalent, that a time-scale is needed to which each can be referred. The absolute duration of the divisions on the time-scale is a matter of pure conjecture; but their relative duration can be roughly estimated from the thickness of the rocks. An attempt is made to represent this relative duration by the diagram to the right, which is based on the thickness of the rocks in N.W. Europe.

[To be inset by this edge opposite p. xvi.]

TIME
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was the dominant type.]

RELATIVE LENGTHS OF EPOCHS AS REPRESENTED BY THICKNESS OF ROCKS.

TERTIARY. 1,600 ft.
CRETACEOUS. 2,500 ft.
JURASSIC. 5,000 ft.
TRIASSIC. 3,000 ft.
PERMIAN. 1,500 ft.
CARBONIFEROUS. 12,000 ft.
DEVONIAN. 4,000 ft.
SILURIAN. 7,000 ft.
ORDOVICIAN. 15,000 ft.
CAMBRIAN. 12,000.
PRECAMBRIAN. Extent unknown.

A GEOLOGICAL TIME-SCALE, WITH EXAMPLES OF FOSSILIFEROUS ROCKS.

ERAS	EPICHR.	AGES.	BRITISH.	EUROPEAN.	RANGE IN TIME OF LIFE-GROUP.	
CAINOZOIC or TERTIARY.	HOLOCENE	PRESSENT DAY HISTORIC NEOLITHIC	Brown sand, alluvium, beaches, tufa, peat, shell-beds, &c., as now forming.			
	PLEISTOCENE	PALÆOLITHIC GLACIAL	Alluvium, &c., as above; valley-gravels, boulder-clays, brick-earth.			
	PLIOCENE	SICILIAN ASTIAN FLIADANCIAN	Norfolk Forest-bed, Wexford Gravels.	Palermo Limestone. Ponderian Sands, Bohemia Boetian " "		
	MIOCENE	TORTOSIAN HELVIETIAN BERGALLIAN AQUITANIAN		Leitha Kalk. Oeningen molasse. Globigerina Lst., Malta. Beauce Limestone.		
	OLIGOCENE	RUPELIAN TONGHIAN FLIADANIAN	Hamstead Bembridge Osborne and Beaulieu	Fontainebleau Sandstone Sables d'Etampes. Prinsboens Marls.		
	Eocene	BARTONIAN LUTETIAN YPRESIAN LANDESIAN	Barton and Bagshot Bracklesham Alum Bay Beds London Clay, Tinnest Sands	Gypsum of Montmartre Calcaire grossier. Sables de Ypres. Sables de Brachet. Pouhange de Cilly. Lat. of Mons and Meudon. Faxe and Maestricht Chalk. Gosau-beds. Fluvi-Mergel. Tourtia.		
	MESOZOIC or SECONDARY.	CRETACEOUS	MUSTIAN DAMIAN SEIXONIAN TURONIAN CENOMANIAN ALBIAN APTIAN BARREMIAN NEOCOMIAN	Chalk in Norfolk and Charing detritus Upper Chalk Middle Chalk Lower Chalk; Chalk Marl Upper Greensand; Red Chalk; Gault Lower Greensand Atherfield Clay; Purfield Beds Specton Clay; Tealby Beds	Wenden Puntlack	
		JURASSIC	PORTLANDIAN KIMMERIDGIAN CORALLIAN OXFORDIAN CALLOVIAN BATHONIAN BAJOCHIAN ALENIAN TOARCIAN PLIENSBACHIAN SINEMURIAN HETTANGIAN	Portland Stone and Sands Kimmeridge Clay Corallian Limestone. Amphill Clay Oxford Clay & Kellaways Rock Cornbrash; Forest Marble; Great Oolite Middle Inferior Oolite Chalkenhams Beds; Northampton Sands Upper Lias, Cotteswold Sands Mid Lias, Marlstone, Cleveland Ironstone Lower Lias " " Blue Lias	Tithonic, Diphys-Kalk. Wobser Jura "	

[To be read by their edges opposite p. 200.]

RELATIVE LENGTHS OF EPOCHS AS REPRESENTED BY THICKNESS OF ROCKS.

<p> TERTIARY. 1,000 ft. CRETACEOUS. 2,500 ft. JURASSIC. 5,000 ft. TRIASSIC. 3,000 ft. PERMIAN. 1,500 ft. CARBONIFEROUS. 1,500 ft. DEVONIAN. 4,000 ft. SILURIAN. 7,000 ft. ORDOVICIAN. 1,000 ft. CAMBRIAN. 12,000. PRECAMBRIAN. Extent unknown. </p>	<p> The range of each group is defined so as to include the time which it was the dominant type. </p>
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A large series of rocks of which only the uppermost have yielded fossils, and those for the most part obscure, as the worn limestones in the Longmynd.

A GUIDE

TO THE

FOSSIL MAMMALS AND BIRDS.

GALLERIES Nos. 1, 2.—FOSSIL MAMMALIA.

THE Mammalia, or warm-blooded quadrupeds which nourish their young with milk, are so modern, geologically speaking, that most of their fossil remains occur in comparatively superficial deposits where they have not been much petrified or mineralised. A large proportion of the fossil bones of this Class thus appear almost as fresh as those of newly-prepared skeletons, being merely stained by the sand or mud in which they have been buried. Some of the bones, from the most recent deposits and Pleistocene formations, are indeed changed only by the loss of their animal-matter, which causes them to become brittle and powdery; and when these are disinterred it is necessary to harden them by treatment with a solution of gelatine or glue, which often produces a shiny surface. Most of the bones from the sandstones, shales, and limestones of the earlier Tertiary formations, have their animal-matter replaced by silica and oxides of iron, which also fill their interstices and impart to these specimens a natural hardness.

The fossil Mammalia are arranged in the Galleries not according to their geological age but primarily in the natural groups recognised by zoologists. The extinct representatives of each Order are placed together, the various Sub-orders and Families being usually arranged in a descending scale from the highest to the lowest. This arrangement within the Order obviously corresponds more or less with the geological succession of its various representatives; for the higher groups occur later in time, the lower groups earlier.

The series begins on the right-hand side of the entrance to Gallery No. 1 and is continued round this Gallery to the left-hand side of the same entrance. The peculiar Mammalia of the Orders Edentata, Marsupialia, and Monotremata are placed in Gallery No. 2. Many of the larger specimens are necessarily mounted on separate pedestals or in separate cases, not in their exact systematic position but as near the allied fossils as possible.

BONE-BEDS.

Case A. Most of the fossil remains of Mammalia are obtained from "bone-beds" or great accumulations of bones, which have been formed by the death and rapid burial of large troops of animals, or by the washing together of portions of skeletons by streams and currents. In the Island of Samos, for example, there is an extensive bone-bed of Lower Pliocene age, which seems to have resulted from the destruction of herds of quadrupeds by a fall of volcanic dust from some neighbouring eruption. In Greece there are several bone-beds also of Lower Pliocene age, which must have accumulated rapidly in lakes or temporary pools. These have been excavated especially at Pikermi, near Athens, and a fine slab from one of them, presented by Mr. Alexander Skousés, is shown in a special Case A, near Table-case 1. In this small specimen (Plates II, III) there are remains of carnivores, antelopes, gazelles, the three-toed horse (*Hipparion*), and two birds, crowded together in red marl, which was originally mud washed down from the neighbouring marble-range of Pentelicon. Many of the bones are in natural association (as, for instance, those of one bent leg of *Hipparion*), showing that parts of the skeletons were buried rapidly before all the ligaments and muscles which held them together had decayed. At Olivola, in the Carrara Mountains, Italy, there is an Upper Pliocene torrent-deposit filled with bones and pebbles; and good examples of this are shown in Pier-case 2 (top shelf). In many places, in the deposits left by rivers, there are great collections of bones brought together by eddying currents, such as those discovered in the valley of the Thames during the working of brick-fields at Ilford and Crayford. There are also numerous fissures, especially in limestone districts, largely filled with accumulations of bones which have fallen or been washed into them. When these bones are mingled with angular fragments of rock and



Block of Lower Pliocene Marl from Pikermi, Greece, crowded with remains of Mammals and a few bones of Birds; about one-fifth nat. size. The central skull belongs to *Hipparion*, the surrounding bones to *Hipparion*, various antelopes, and one small carnivore. (Case A.)

[To face p. 2.]



Block of Lower Pliocene Marl from Pikermi, Greece, crowded with bones (opposite side of specimen shown in Plate II.). The bent hind limb of *Hipparion* is conspicuous, surrounded by other bones of this animal and antelopes, with bird-bones below. (Case A.)

[To face p. 3.

cemented together by carbonate of lime, they are termed **Pier-case 2.** "bone-breccias" (Italian *breccia*, a crumb). Examples are shown from Gibraltar, from Minas Geraes, Brazil, and from the Wellington Caves, New South Wales (Pier-case 2, top shelf). Treacherous ground, like a swamp or peat-bog, is often rich in the skeletons and other remains of animals which have become mired by accident. The salt marshes or "lieks" of North America thus yield remarkable skeletons of the mastodon (Stand B), while the tundras of Siberia entomb innumerable carcasses of the mammoth and woolly rhinoceros.

CAVERNS.

The bone-bearing deposits on the floors of caverns in limestone districts are particularly interesting, because in many cases the fossil remains have not been introduced by accident, but by men or wild beasts which have inhabited these retreats. In England and Wales, for example, a large proportion of the caverns were hyæna-dens during the Pleistocene period, and the remains both of the hyænas and of their prey are found in the red clay covering the floor. Other caverns were inhabited by primitive man, either exclusively by him or only at times when the hyænas were driven out; and in such cases there are articles of human workmanship, traces of fire, and even bones of man himself, in the same kind of deposit. This "cave-earth," as it is termed, is mainly the residue of decomposed limestone, and it is mixed with drippings of lime-water, which evaporate and leave a crust of carbonate of lime. When a cavern becomes deserted and the drippings are undisturbed, the limy crust thickens slowly into a layer of "stalagmite," which seals up whatever may be beneath in a permanent state of preservation. A specimen of the resulting floor from Brixham Cave, near Torquay, enclosing an antler of a reindeer, is seen in **Wall-case 1.** An interesting piece of stalagmite enclosing human remains, from the cavern of Bruniquel, France, is also shown in the same case. **Pier-case 2.**
Table-case 1.

MAMMALS OF PLEISTOCENE EUROPE.

Unfortunately, the surface of the land changes so rapidly by weathering and "denudation" (natural wearing down and washing away), that no once-inhabited caverns hitherto discovered date back further than the Pleistocene period.

Wall-case 1. For this comparatively modern geological epoch, however, they have furnished a nearly complete idea of the human races and the animal life inhabiting western Europe at least; and a typical collection of remains illustrating this story is exhibited in Wall-case 1, Pier-case 2, Table-case 1, and two adjoining special frames.

Pier-case 2. The western portion of continental Europe in the Pleistocene period included the British Isles, which had not at that time been separated from the mainland. The probable extent of the land is shown by a map on the pillar adjoining Pier-case 2. The hollow at present occupied by the North Sea would then be a wide valley or plain through which rivers flowed; and it was inhabited by troops of mammals whose remains lie scattered in abundance over the Dogger Bank and other portions of the existing floor of the sea. These bones and teeth are continually dredged up by the fishermen, and a typical series of them, from the collection of Mr. J. J. Owles, of Great Yarmouth, is shown in Pier-case 2. Here there is evidence of wolf, hyæna, bear, beaver, ox, bison, an extinct fallow-deer (*C. browni*), Irish deer, reindeer, elk, horse, woolly rhinoceros, and mammoth. Though the specimens were doubtless originally buried in the sands and gravels deposited by the rivers, they must have been washed out by the scour of the tides and currents, for they have lain for some time exposed on the sea-bed, as shown by the remains of serpulæ, oyster spat, and other marine organisms upon them.

Wall-case 1. As proved by the fragmentary bones and teeth exhibited in Wall-case 1 and Pier-case 2, the British caverns yield evidence of a remarkable series of mammals living together in this part of Europe during the Pleistocene period, some being now confined to the Arctic Regions, others to the Tropics, others still living here, and some now quite extinct. The complete list (except rats, mice, etc.) is as follows:—

NORTHERN AND ARCTIC MAMMALIA.

Glutton (*Gulo luscus*).
 Arctic Fox (*Canis lagopus*).
 Reindeer (*Rangifer tarandus*).
 Lemming (*Myodes lemmus* and *Cuniculus torquatus*).
 Pica (*Lagomys pusillus*).
 Marmot (*Arctomys marmotta*).
 Souslik (*Spermophilus erythrogenoides*).

TEMPERATE MAMMALIA.

Wall-case
1.
Pier-case 2.

Wild Cat (*Felis catus*).
Lynx (*Felis lynx*).
Otter (*Lutra vulgaris*).
Badger (*Meles taxus*).
Stoat (*Mustela erminea*).
Weasel (*Mustela vulgaris*).
Marten (*Mustela martes*).
Fox (*Canis vulpes*).
Wolf (*Canis lupus*).
Brown Bear (*Ursus arctos*).
Grizzly Bear (*Ursus horribilis*).
Horse (*Equus caballus*).
Bison (*Bison bonasus*).
Roebuck (*Capreolus caprea*).
Stag (*Cervus elaphus*).
Wild Boar (*Sus scrofa*).
Hare (*Lepus europæus*).
Rabbit (*Lepus cuniculus*).
Beaver (*Castor fiber*).

SOUTHERN MAMMALIA.

Lion (*Felis leo*).
Leopard (*Felis pardus*).
Kaffir Cat (*Felis caffra*).
Spotted Hyæna (*Hyæna crocuta*).
Hippopotamus (*Hippopotamus amphibius*).

EXTINCT MAMMALIA.

Sabre-toothed Tiger (*Machærodus latidens*).
Short-nosed Cat (*Felis brevirostris*).
Cave-bear (*Ursus spelæus*).
Woolly Rhinoceros (*Rhinoceros antiquitatis*).
Narrow-nosed Rhinoceros (*R. leptorhinus*).
Large-nosed Rhinoceros (*R. megarhinus*).
Irish Deer (*Cervus giganteus*).
Urus (*Bos primigenius*).
Mammoth (*Elephas primigenius*).
Straight-tusked Elephant (*Elephas antiquus*).

The remains of some of these animals have an interesting distribution. The cave-bear occurs most abundantly in the oldest layer of the floor, as in Kent's Cavern and the Creswell Caves. It is the only animal found in some of the caverns of Franconia and the Harz Mountains, Germany, where most of the individuals are aged and seem to have retreated to these quiet spots to die. The British lion appears to have been most numerous in the neighbourhood of the Mendip Hills. The hippopotamus ranged as far north as Kirkdale Cave in the Vale of Pickering, Yorkshire. The

Wall-case 1. mammoth occurs chiefly in the hyæna-dens, where it is represented only by the teeth of young individuals which would be a much more ready prey than the full-grown beasts. Pier-case 2. The hyæna-dens are easily recognised, not merely by the abundance of the remains of the hyænas themselves, but also by their "coprolites" (or fossilised excrement) and the gnawed bones of their prey. The tooth-marks of these animals are often quite distinct; and the long bones of their prey are usually represented only by the middle of the shaft, the ends having been gnawed away until the hyænas could scoop out the whole of the marrow with their tongue. Very good examples are exhibited from the Brixham, Doward's Wood, Wookey, and Creswell Caves.

The old river-deposits in the valley of the Thames, which are contemporaneous with the lower cavern deposits, have yielded remains of the same mammals as the latter, with the addition of the elk (*Alces machlis*), the musk-ox (*Oribos moschatus*), and the saiga antelope (*Saiga tatarica*). These will be referred to again when treating of the systematic collection.

MAN ASSOCIATED WITH PLEISTOCENE MAMMALS.

Table-case 1. During the whole of the Pleistocene period, while the mammals just enumerated lived in Western Europe, man was undoubtedly present as a wandering hunter. Very few of his bones occur; but his implements of stone and bone, with occasional traces of his fires, are found in intimate association with the remains of the wild beasts. A few examples of the primitive implements are arranged in Table-case 1 and in the drawers of an adjacent cabinet, which contains the greater part of the late Sir Joseph Prestwich's collection.

All the stone implements found in the Pleistocene deposits are of the "Palæolithic" or ancient-stone-age type, *i.e.*, they are roughly chipped (not polished), and their broadest end would be grasped or fixed, while their narrowest or pointed end would be used for chopping, cutting, or scraping. In the valley of the Thames, as in many other places, these implements are of flint; and some of the spots on the river-bank where the Palæolithic hunter actually made his equipment have been discovered. One such "floor," explored by Mr. Flaxman C. J. Spurrell at Crayford in Kent, is illustrated by a selection from his collection in Table-case 1. Here are the flakes which were struck

away in trimming the flint-nodules to shape, and among them is a broken jaw of a woolly rhinoceros, which may possibly represent part of the workman's food. There are also completed implements. One example was accidentally broken before it was finished, and so thrown away. Mr. Spurrell recovered the two pieces, and also the numerous flakes which were struck off in the fashioning of it. With

Table-case
1.

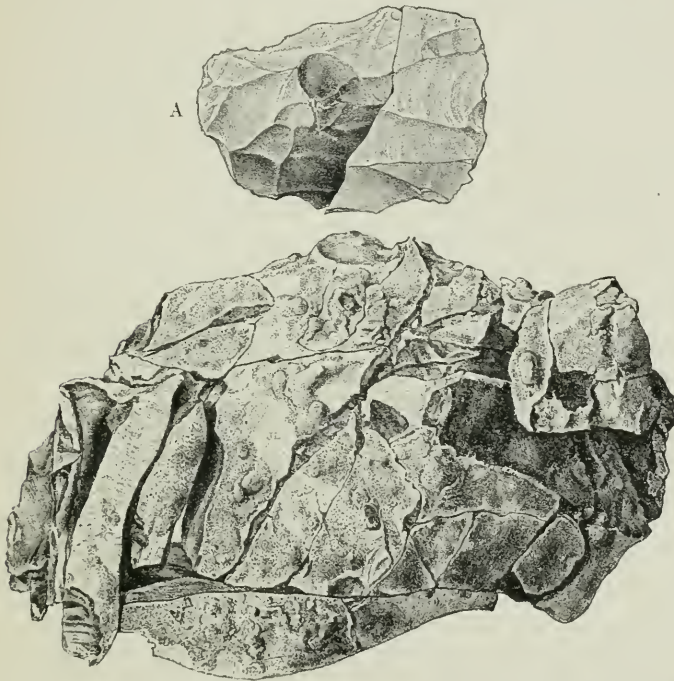


FIG. 1.—Block of Flint from Crayford, Kent, broken by Palaeolithic Man in making an implement (A), which was never finished because it was accidentally fractured; one-third nat. size. (Spurrell Collection, Table case 1.)

great patience and skill he replaced all the flakes, thus restoring the flint-nodule to the original form which it had when Palaeolithic man selected it for his work (Fig. 1).

Table-case
1.

The finest and most varied Palaeolithic stone implements (flint or chert) are found with the bones of the Pleistocene mammals in the higher layers of the caverns. They denote a more advanced race of men, which Professor Boyd Dawkins

Table-case 1. has compared with the living Eskimo. The stone implements are supplemented by bone harpoons, bone pins or awls, and even by well-made bone needles. The sinews of reindeer were doubtless used for sewing together skins, just as they are employed by the Lapps and Eskimo at the present day. Pierced teeth were probably strung together into necklaces and armlets. There are also incised bones, with outlines roughly portraying the animals of the chase. Examples of the stone and bone implements from Kent's Cavern, Torquay, and from the French caverns, are shown in Table-case 1. One incised reindeer antler in the same Case from a French cavern displays the rough outline of the fore-part of a horse. Plaster casts of more celebrated bone implements and outline sketches of the same age, are placed in a frame on the wall adjoining the window.

This small selection of the handiwork of Palæolithic man is exhibited here merely to illustrate his association with the Pleistocene mammals. The principal collection both of Palæolithic and later workmanship in the British Museum is placed in the Department of British and Mediæval Antiquities at Bloomsbury, and is described in "A Guide to the Antiquities of the Stone Age," obtainable at the British Museum, Bloomsbury, W.C.

The late Sir Joseph Prestwich and some other geologists have expressed the opinion, that there is evidence of the presence of man in western Europe at a remote time even before most of our valleys were excavated and before the present drainage-system of our land was established. This evidence consists in rough pieces of flint, which seem to have been chipped artificially along one or more edges, and may have been used by man. These supposed implements were first noticed by Mr. Benjamin Harrison in the high-level plateau-gravels, probably of Upper Pliocene age, in Kent; and many of his specimens are included in the Prestwich Collection, of which the principal series is exhibited in Table-case 1. They are termed "eoliths" by those who believe that they represent the dawn of the Stone Age of Man.

BRITISH PLIOCENE MAMMALS.

Table-case 1a. Very little is known of the mammals inhabiting the British area during the Pliocene period. They are only represented by very fragmentary remains in the marine Pliocene Crag deposits of East Anglia, and by equally un-

satisfactory teeth and bones found in a fissure in the Carboniferous Limestone near Buxton, Derbyshire. A typical series of the Crag fossils is exhibited in Table-case 1a. *Mastodon*, *Hipparion*, *Tapirus*, *Gazella*, and *Hyænarcos*, are the most noteworthy genera. Some of the specimens may have been washed out of Miocene deposits.

SYSTEMATIC COLLECTION.

CLASS.—MAMMALIA.

SUB-CLASS I.—EUTHERIA.

ORDER I.—PRIMATES.

SUB-ORDER 1.—*Anthropoidea*.

As already mentioned, the bones and teeth of man are very rare in geological formations—he is usually represented merely by his handiwork. A few important specimens, however, have been discovered, and plaster casts of these are exhibited in Table-case 1. There is a copy of the top of a skull, of a very lowly type, found with the remains of Pleistocene mammals in a cavern in the Neanderthal, near Düsseldorf, Germany. There are also copies of two imperfect skulls and some limb-bones of a similar lowly kind of man discovered in undoubted association with Pleistocene mammals in the cavern of Spy, near Namur, Belgium. These specimens seem to represent a human race inferior to any now existing, but comprising powerfully built individuals. The forehead is low; the bony ridges above the eyes are very prominent; and the chin is somewhat retreating. The radius and ulna are unusually divergent in the middle of the fore-arm. The femur is somewhat bent, and the tibia is comparatively short, so that the leg cannot have been quite upright in walking.

Most of the actual bones of man preserved in the collection are probably quite modern compared with the primitive race just mentioned. In Table-case 1 there are parts of the skeleton of an aged man found at a depth of 34 feet in the Thames mud during the excavation of Tilbury Docks. In Pier-case 2 is placed the famous human skeleton

Table-case
1.
Pier-cases
2, 3.

Pier-case 2. fossilised in limestone, which was obtained in 1813 by Sir Alexander Cochrane, R.N., from the island of Grande-Terre, near that of Guadeloupe in the West Indies. The rock in which this specimen was discovered is quite a modern beach-formation.

Table-case 1. The oldest known traces of a man-like skeleton are the roof of a small skull, two grinding teeth, and a diseased femur, discovered by Professor E. Dubois in a bed of volcanic ash containing remains of late Pliocene or early Pleistocene mammals near Trinil in Java. A plaster cast of the piece of skull is placed in Table-case 1. It shows that the capacity of the brain-case in this animal, which has been named *Pithecanthropus erectus*, can scarcely have exceeded two-thirds that of the average man. The forehead is very low, and the bony ridges above the eyes are prominent.

Pier-case 3. The man-like apes or **Simiidae**, which are represented at the present day by the gibbons, orangs, chimpanzees, and gorillas, in the tropics of Asia and Africa, also lived in southern Europe in the latter part of the Miocene period. A characteristic thigh-bone of one of these apes (*Panlopithecus rhenanus*) has been found in the lowest deposits of the Pliocene period even so far north as Eppelsheim, Hesse-Darmstadt. All the fossil forms are known merely by pieces of jaws and isolated limb-bones, of which plaster casts are exhibited in Pier-case 3.

The Old World monkeys are proved to date back to the Middle Miocene period in Europe. *Mesopithecus*, from the Lower Pliocene of Pikermi, near Athens, is known by nearly all parts of the skeleton, and fine skulls are shown in Pier-case 3. It is allied to the living Indian *Simnopithecus*. *Macacus*, which still survives in Europe on the rock of Gibraltar, is represented by one molar tooth (named *Macacus pliocenus* by Owen) from the Pleistocene brick-earth of Grays, Essex.

SUB-ORDER 2.—**Lemuroidea.**

Pier-case 3. The lemurs, which are evidently of a lower grade than the monkeys and apes, immediately preceded these Anthropoidea both in Europe and North America, and became extinct, at least in Europe, as soon as the latter appeared. They were quite abundant in both regions during the Eocene and Oligocene periods. Fine skulls and other remains of *Adapis* and *Necrolemur*, which are typical lemurs from the

red Phosphorites of southern France, are shown in Pier-**Pier-case 3.** case 3. There are also jaws of the same animals from the Upper Eocene of Hordwell, Hampshire (Fig. 2), and teeth of allied genera from the Eocene of Dakota, U.S.A. At the present day the lemurs are confined to Madagascar, parts of Africa and the southern Asiatic region. They are especially characteristic of Madagascar, and are all small animals adapted exclusively for a life in trees. In the surface deposits and caverns of Madagascar their fossil remains are numerous, and among these it is easy to recognise large and even gigantic extinct kinds (*Nesopithecus*, *Megaladapis*, etc.) which lived in the Pleistocene and Prehistoric periods.

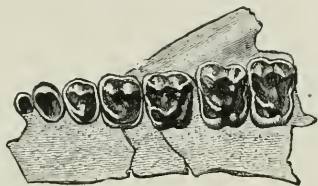


FIG. 2.—Palatal view of left upper teeth of a Lemur (*Adapis magna*) from Upper Eocene, Hordwell, Hampshire; nat.size. (Pier-case 3.)

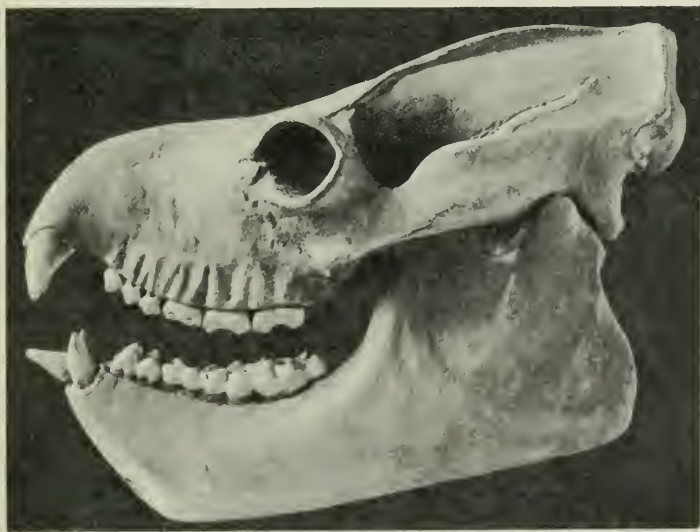


FIG. 3.—Model of skull and lower jaw of a supposed aquatic Lemur (*Megaladapis insignis*), from a Cavern in Madagascar; one quarter nat. size. (Pier-case 3.)

The largest species of *Megaladapis* (*M. insignis*), of which various fragments are exhibited and of which a restored

Pier-case 3. model of the skull (Fig. 3) is placed on the top shelf of Pier-case 3, must have been about as large as a donkey. It clearly did not live in trees, and may perhaps have been adapted for an aquatic life. The bony rims of the orbits are curiously produced like those of a hippopotamus.

ORDER II.—CARNIVORA.

SUB-ORDER 1.—Carnivora Vera.

Pier-case 3. The true cats or **Felidæ** are well represented among fossils, which trace back the ancestry of this highest surviving tribe of flesh-eaters to Miocene European animals much resembling the existing *Cryptoprocta* of Madagascar. *Felis* itself first appears in the Middle or Upper Miocene of Europe, and culminated in the great cave-lion, which is probably only a variety of the existing *Felis leo* of Africa and Asia. Among the numerous remains of this animal in Pier-case 3 may be particularly noticed the fine skull obtained by Mr. Flaxman Spurrell from the Pleistocene brick-earth of Crayford, Kent. There are also jaws and bones of a lynx from a cavern in Cales Dale, Derbyshire. The small ancestral Felidæ are represented by jaws of *Pseudælurus* and *Proælurus* from the Miocene of France.

Pier-case 3. Still more deadly than the Felidæ must have been the
Stand D. extinct **Nimravidæ** or **Machærodontidæ**, of which many were as large as lions, with over-grown upper canine teeth and with fore limbs as effective as grappling irons. A plaster cast of a complete skeleton of *Machærodus* from the pampa of South America (now in the National Museum, Buenos Aires), is placed on Stand D, and there are various remains of this and allied genera in Pier-case 3. *Machærodus* is often named the "sabre-toothed tiger," in allusion to its large laterally-compressed upper canine teeth, which have finely serrated edges. The mouth seems to have opened to an abnormal extent to permit the effective use of these terrible weapons (Fig. 4). As shown by the fragmentary fossils, *Machærodus* is represented first in the Miocene of France and Germany; next in the Pliocene of France, England, Italy, Greece, Hungary, the Isle of Samos, Persia, and India; and finally by the largest species in the Pleistocene of France, Germany, Italy, England, North America, Ecuador, Brazil, and Argentina. Teeth from Kent's Cavern and the Creswell Caves prove its association with the cave

men in England. The complete extinction before historic times of so widely-spread an animal is very remarkable. *Hoplophoneus*, of which skulls are exhibited, is an allied



FIG. 4.—Diagram of head of the “Sabre-toothed Tiger” (*Machærodus neogæus*), from the Pampa Formation of Buenos Aires, Argentine Republic, showing the widely open mouth; one-eighth nat. size. (After W. D. Matthew.)

genus from the Oligocene White River Formation of North America. *Eusmilus* and *Aelurogale*, represented by jaws, are small ancestral forms from the Oligocene Phosphorites of southern France.

In the exhibition of remains of **Hyænidæ** (Pier-case 3) the largest space is occupied by the European cave-hyæna, which seems to have been essentially identical with the existing spotted hyæna (*Hyæna erocuta*) of Africa. Individuals in all stages of growth are represented by the jaws and teeth from the English caverns, and by other fragments from river deposits and the Norfolk Forest Bed. Other true hyænas are known by fossils from the Lower Pliocene of Greece, Samos, Persia, and India; but there are no traces of the family in America. *Ichitharium*, from the Lower Pliocene of Greece, Samos, Persia, and India, is known not only by fine skulls, of which there are some in Table-case 2, but also by the greater part of the skeleton. It is an ancestral genus, connecting the Hyænidæ with the Viverridæ.

The **Viverridæ**, or civets, mongooses, and their allies,

Table-case 2. are very old Carnivora, which appear to have been always small animals confined to the Old World. As shown by remains in Table-case 2, *Viverra* itself seems to have lived unchanged from the Upper Eocene period to the present day.

The **Mustelidæ**, or weasels, badgers, and otters (Table-case 2), also date back to the Upper Eocene period, beginning in the Old World and then spreading to America. The occurrence of the glutton (*Gulo luscus*) in the English and Welsh cave-earths, and in the Forest Bed, is interesting.

The raccoons, or **Procyonidæ**, are scarcely known among fossils; but teeth from the Red Crag (Lower Pliocene) of Suffolk seem to belong to the existing Indian *Ailurus* or a closely allied genus (plaster cast in Table-case 2).

Pier-case 3. The **Canidæ**, or wolves, foxes, jackals and dogs, have scarcely changed in any essential respects since the Miocene period, when they already flourished both in the Old World and in North America. Murchison's famous "fossil fox of Oeningen," from the Upper Miocene of Baden, is a typical member of the family. *Cynodictis* and allied genera (Table-case 2), from the Oligocene Phosphorites and the Upper Eocene of France, connect the Canidæ with the Viverridæ.

Pier-case 4. The bears, or **Ursidæ**, which are at present distributed over nearly all the world, except Australia and New Zealand, have only had so wide a range since the dawn of the Pleistocene period. So far as known, the family began its

Table-case 3.

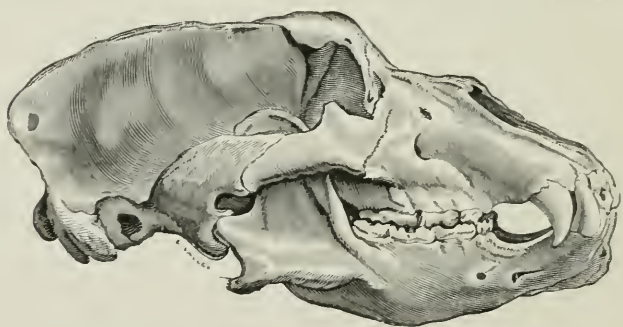


FIG. 5.—Skull and lower jaw of the Cave-bear (*Ursus spelæus*), from a Pleistocene Cavern Deposit in Bavaria; about one-sixth nat. size.

existence in Europe and Asia, where there are many remains of Pliocene, Miocene, and Oligocene animals which must be regarded as ancestors. The true bears of modern times are mixed feeders, and have teeth modified accordingly. In the

Pleistocene period an extinct species of very large size, whose remains are frequently found in the caverns of Europe, is named the cave-bear (*Ursus spelæus*). A skeleton, reconstructed from the bones of several individuals from French caverns, is exhibited in Pier-case 4. Remains of this species (Fig. 5) are common in the English and Welsh caverns, but it does not appear to have reached Ireland or North America.

A curious snub-nosed bear (*Arctotherium*), also of large size, existed in the Pleistocene period in America; and a partially reconstructed skeleton of it, from the pampa of Buenos Aires, is mounted in Pier-case 4. In the Pliocene of Europe and Asia, and in the Miocene of Europe, there are bear-like quadrupeds with square (not elongated) upper grinding teeth (Fig. 6).

A very large species, *Hyænarcos sivalensis*, from the Siwalik Formation of India, is represented by a fine skull and other remains in Pier-case 4. This animal seems to have differed from the bears and resembled the dogs in having a very prominent elbow. Older fossils from the Miocene and Oligocene of Europe, named *Amphicyon* and *Cephalogale* (Fig. 7), belong to animals

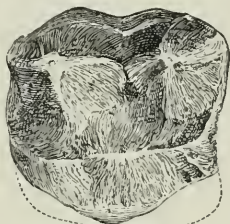


FIG. 6.—View of grinding surface of molar tooth of *Hyænarcos*, from the Red Crag of Suffolk; nat. size.

Pier-case 4.



Table-case 2.

FIG. 7.—Right ramus of lower jaw of a primitive dog-like, bear-like Mammal (*Cephalogale brevirostris*), from the Oligocene Phosphorites of France; nat. size.

of a strictly flesh-eating kind, which were neither bears nor dogs, but intermediate between the two families. Good examples of the dentition are seen in Table-case 2.

SUB-ORDER 2.—**Creodonta.**Table-case
2a.

The true Carnivora can thus be traced back to the Upper Eocene, when most of them were small creatures closely

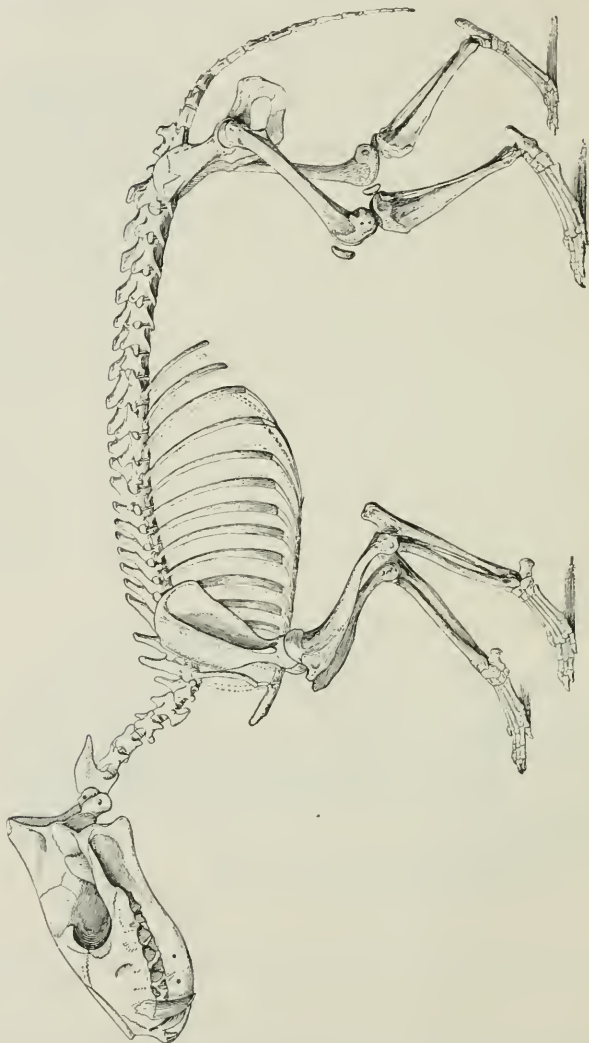


FIG. 8.—Skeleton of a Creodont (*Hyenodon cruentus*), from the Oligocene of Dakota, U.S.A.; one-seventh nat. size. (After W. B. Scott.)

resembling the existing Viverridæ. They are preceded in the Middle and Lower Eocene, both in the Old World and

in North America, by peculiar lowly Carnivora with a comparatively small brain, in which the cerebral hemispheres are nearly smooth and do not cover the mid-brain. In these animals there is no special "sectorial" or "carnassial" (flesh-cutting tooth) near the back of the jaw, and the whole dentition is very similar to that of the flesh-eating pouched animals (Marsupialia) now living in Australia and Tasmania. They were, in fact, regarded as Marsupialia for many years, until it was discovered that some of them possessed a complete milk-dentition which was replaced by the usual permanent teeth. The existing Marsupialia never have more than one milk-tooth replaced on each side of either jaw. Table-case
2a.

These Creodonta ("flesh-teeth"), as they are termed, were sometimes as large as lions or bears, and survived in the northern hemisphere at least until the beginning of the Miocene period. A typical series of remains, chiefly of the Upper Eocene and Oligocene genera *Hyænodon* (Fig. 8) and *Pterodon*, is shown in Table-case 2A. A fine jaw of a large *Pterodon* from the Upper Eocene of Egypt is especially noteworthy.

The so-called **Sparassodonta** from the early Tertiary of South America seem to have been Creodonts in which only one or two of the premolars and the canine were preceded by milk-teeth. A skull and portions of jaws of *Borhyaena* and *Prothylacinus*, from the Santa Cruz Formation of Patagonia, are exhibited in Table-case 2A.

SUB-ORDER 3.—**Pinnipedia.**

The seals, walruses, and their allies are scarcely represented among fossils, and no important ancestors are known. The tusks of a large walrus (*Trichecodon huxleyi*) have been found in the Pliocene Red Crag of Suffolk (see Table-case 1A). A few fragments of seals from the Norfolk Forest Bed are shown in Table-case 3; and with these are plaster casts of other remains from the Pliocene Crag of Belgium. Table-cases
1a, 3.

ORDER III.—**INSECTIVORA.**

Among the fragmentary fossil remains of the shrews, moles, and hedgehogs, there are none of much interest; but they date back at least to the close of the Eocene period. Table-case
2a.

Table-case 2a. Jaws and limb-bones of the desman (*Myogale moschata*), an animal now confined to south-east Russia, are shown from the Norfolk Forest Bed.

ORDER IV.—**CHIROPTERA.**

Table-case 2a. Fossil skeletons discovered in France prove that the bats were as completely formed in the Upper Eocene as they are at the present day; but there are only imperfect skulls and jaws in the collection of the Museum (Table-case 2a).

ORDER V.—**UNGULATA.**

As the hoofed animals are traced backwards through geological time, the fossils gradually lead to small marsh-dwelling or forest-dwelling predecessors, which were adapted to live on succulent vegetation. The existing tapirs, pigs, peccaries, hippopotamus, and chevrotains, are the least altered survivors of this ancestry; while the rhinoceroses, horses, cattle, giraffes, deer, and elephants, with effective grinding teeth, are the highest and newest members of the Order.

SUB-ORDER 1.—**Perissodactyla.**

Pier-cases 6-10. It seems probable that at the dawn of the Eocene period all the hoofed animals were five-toed; but most of them soon began to exhibit a tendency towards the reduction of the spreading foot. In one group comprising the existing tapirs, rhinoceroses, and horses, the whole weight of the body gradually became concentrated on the middle toe, so that this grew stout at the expense of the other toes. Thus arose the uneven-toed hoofed animals or Perissodactyla. The tapirs retain four toes on the fore foot, three on the hind foot; the rhinoceroses, three toes on each foot; and the true horses, only one toe on each foot (see Fig. 9).

Pier-cases 6-8. The **rhinoceroses**, which are restricted to Africa and the Indian region at the present day, wandered far from tropical climes during the Pleistocene period and ranged over nearly the whole of Europe and Asia, being common even within the Arctic Circle. The northern species (*Rhinoceros antiquitatis* or *R. tichorhinus*) seems to have been most closely related to the nearly extinct square-nosed rhinoceros (*R. simus*) of Africa. It is commonly known as

the "woolly rhinoceros," because its mummified remains, which are discovered in the frozen tundras of Siberia, prove that the skin was covered with wool and long hair. It possessed two horns, of which the foremost was so large that the usually gristly partition between the right and left halves of the nose-cavity became bony for a support, and this is always conspicuous in well-preserved skulls. The actual horns (which are never bony in rhinoceroses, but

Pier-cases
6-8.
Table-case
4.

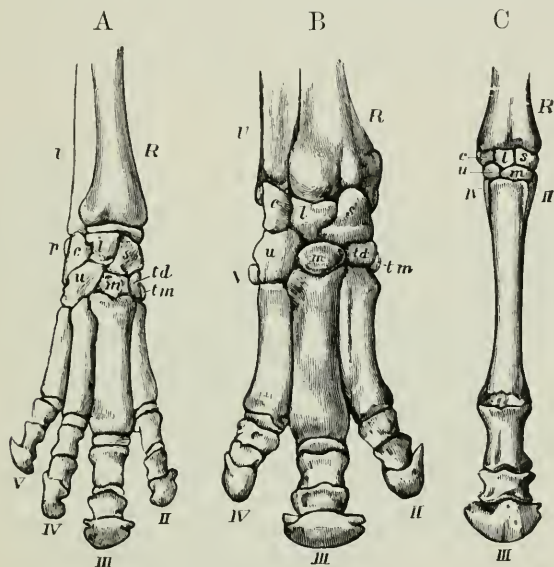


FIG. 9.—Skeleton of Fore foot of three existing Perissodactyl or Uneven-toed Ungulata—namely, Tapir (A), Rhinoceros (B), and Horse (C), much reduced in size. R, radius; U, ulna; c, cuneiform; l, lunar; s, scaphoid; u, unciform; m, magnum; td, trapezoid; tm, trapezium; II, III, IV, V, the several digits. (From Flower's "Osteology of the Mammalia.")

merely hardened clusters of hair) are preserved in the frozen earth of the Arctic Circle, and a small example is exhibited with some skulls in Pier-case 6. The bones and teeth of the woolly rhinoceros are common in British Pleistocene deposits and on the bed of the North Sea; and fine specimens are shown in Pier-case 6 and Table-case 4. Some fragmentary remains from Chartham, in Kent, are especially interesting as being among the earliest discoveries of fossil bones in England to attract notice. They were

Pier-cases
6-8.
Table-case
4.

described by William Somner in 1669 in a small printed tract entitled "Chartham News; or, A Brief Relation of some strange Bones there lately digged up, in some grounds of Mr. John Somner of Canterbury;" but they were wrongly supposed to belong to some "sea-monster." One fine skull and associated bones were found in an excavation beneath the "Daily Chronicle" office in Fleet Street, London. Other fragmentary remains from English caverns prove that this rhinoceros was commonly preyed upon by the hyænas. One oval plate of bone from Kent's Cavern is particularly noteworthy, and exhibits deep tooth-marks round its edge. It

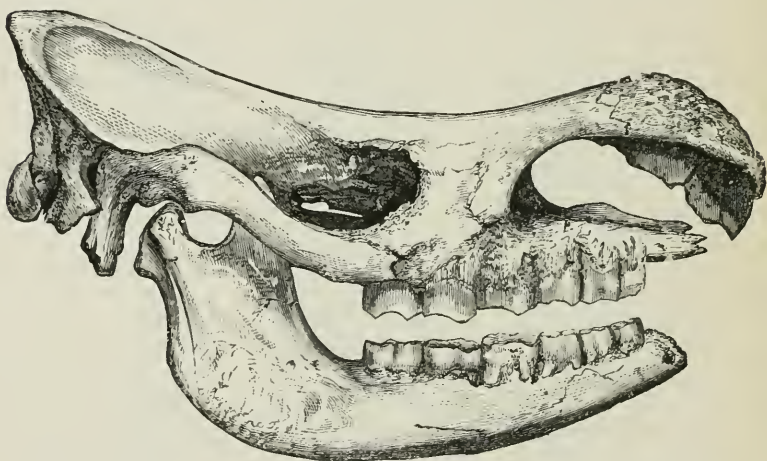


FIG. 10.—Skull and lower jaw of the Slender-nosed Rhinoceros (*Rhinoceros leptorhinus*), from the Pleistocene of Ilford, Essex; one-eighth nat. size. (Brady Collection, Pier-case 6.)

is evidently the bone to which the front horn was fixed at the time when the hyænas gnawed it, and the limit of their gnawing was determined by the size of the base of this horn, which has since decayed.

Pier-case 6.
Table-case
4.

Two other species (*R. leptorhinus* and *R. megarhinus*) are represented in the Pleistocene deposits of England and the adjacent parts of the continent, in association with the woolly rhinoceros. Fine skulls of *R. leptorhinus* (Fig. 10) from the Thames Valley are placed in Pier-case 6; and there are teeth and jaws of this species and *R. megarhinus* both in Pier-case 6 and in Table-case 4. A slightly earlier rhinoceros (*R. etruscus*), which commonly occurs in the Upper Pliocene

of southern Europe, is also represented by jaws and teeth in the Norfolk Forest Bed, from which Mr. Savin collected the series of specimens in Pier-case 7. True two-horned rhinoceroses are found in the Lower Pliocene of Eppelsheim (Hesse-Darmstadt), Pikermi (Greece), the Isle of Samos, and Maraglia (Persia), as shown by fine specimens in Pier-case 8. Pliocene rhinoceroses are likewise found in the Siwalik Formation of India, and here there are not only two-horned species but also direct ancestors of the one-horned species (*R. unicornis*) which now lives in India. Their remains were collected chiefly by Falconer and Cautley and are exhibited in Pier-case 7.

Pier-cases
7, 8.

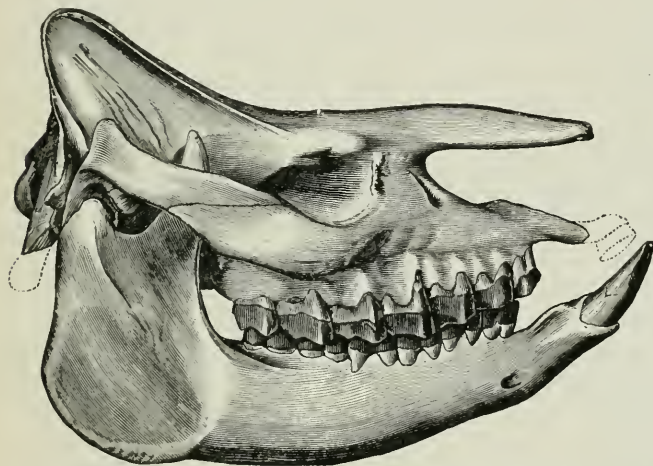


FIG. 11.—Skull and lower jaw of a Hornless Rhinoceros (*Aceratherium megalodus*), from the Upper Miocene of Colorado, U.S.A.; one-sixth nat. size. (After E. D. Cope.)

In the Miocene and Oligocene formations both of Europe and North America, and in the Lower Pliocene of Europe and Asia, there is evidence of numerous ancestral rhinoceroses, most of which were almost or quite hornless (e.g., *Aceratherium*). In fact, the American representatives of the Rhinocerotidae (Fig. 11) seem to have become extinct at the end of the Miocene period, before they had acquired more than the slightest trace of a horn. As in the true modern rhinoceroses, of course, this structure is never fossilised—its presence or absence is merely inferred from the size of the nasal bones and from the presence or absence of a roughness

Pier-case 8.

Pier-case 8. on the bone where the horn would be attached. The earliest rhinoceroses are the smallest and have the front teeth best developed. Some of them (*Hyracodon*), as proved by the shape of the back of the skull, could only use their jaws for crushing or chopping their food, and had not acquired the powerful grinding bite characteristic of their modern representatives. Illustrations are exhibited in Pier-case 8 and Table-case 4.

Pier-case 6. A very peculiar rhinoceros, *Elasmotherium sibiricum*, with a skull more than a yard in length, lived in Siberia and part of south European Russia in the Pleistocene period. It must have borne an enormous horn, not on the nose, but on a bony prominence in the middle of the forehead above the eyes. Its teeth, though formed on the rhinoceros-plan, are shaped like those of a horse. They have crimped enamel and must have been very effective grinders for a long-lived animal. Plaster casts of the skull and other remains are exhibited in Pier-case 6.

Pier-case 8. The **Titanotheriidae**, of the Eocene and Oligocene periods
Case L. in America, seem to have been closely related to the early rhinoceroses. Some typical remains of the latest genus, *Titanotherium* itself, are placed in Pier-case 8, and a fine skull is exhibited in a special Case (marked L). The head is shaped like that of a rhinoceros; but the roof of the nose-cavity bears a pair of small bony horns or horn-cores, and the teeth form an almost or quite continuous series in the mouth. The fore foot has four toes, of which the two middle ones are less unequal than in the tapirs; the hind foot has three toes. Some species attained a very large size, 15 to 18 feet in length (Fig. 12).

Pier-case 10. The typical one-toed horses (of family **Equidae**), which are only found in a wild state at the present day in Africa and Asia, ranged also over Europe and the whole of North and South America during the Pleistocene period. Some of them, whose bones cannot be distinguished from those of *Equus caballus*, wandered even into the Arctic Regions. Most of them belonged to the genus *Equus*, but a few in South America were peculiar, notably the *Hippidium* and *Onhippidium* found in the Argentine Republic. As shown by a plaster cast of the skull in Pier-case 10, the latter genus was characterised by a remarkable development of the nose: it is also known to have possessed unusually short and stout legs. All the American horses seem to have become extinct before the New World was colonised from Europe in historic

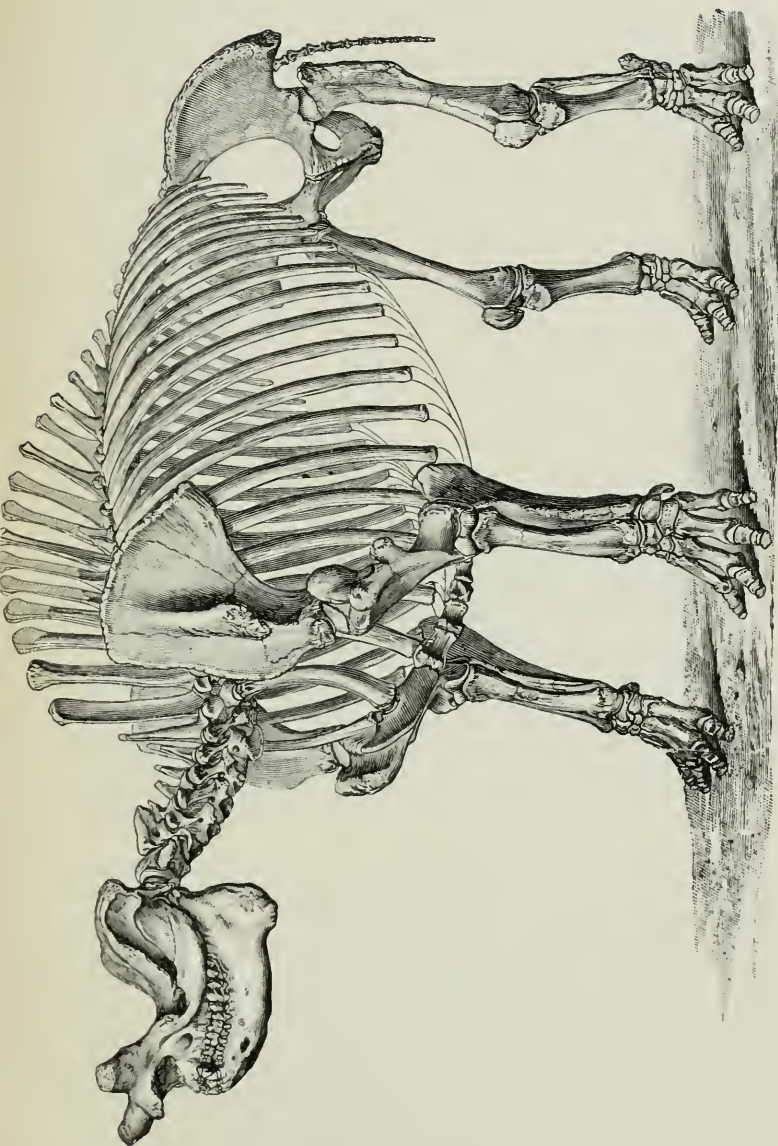


FIG. 12.—Skeleton of *Titanotherium* (*Brontops*) *robustum*, from the Oligocene of Dakota, U.S.A.; about one twenty-fourth nat. size. (After O. C. Marsh.)

times; and the so-called wild horses now found there are merely escapes from domestication.

Pier-case
10.
Table-case
5.

The earliest remains of one-toed horses hitherto discovered (Fig. 13, 1) occur in the Lower Pliocene Siwalik Formation of India (*Equus sivalensis*, Pier-case 10); and they are first found in Europe in the Upper Pliocene, in America in the Pleistocene. Their first appearance in England is in the Norfolk Forest Bed, and their remains are common both in the Pleistocene river-deposits of this country and in caverns (Pier-case 10). These true horses are immediately preceded in Asia, Northern Africa, Europe, and

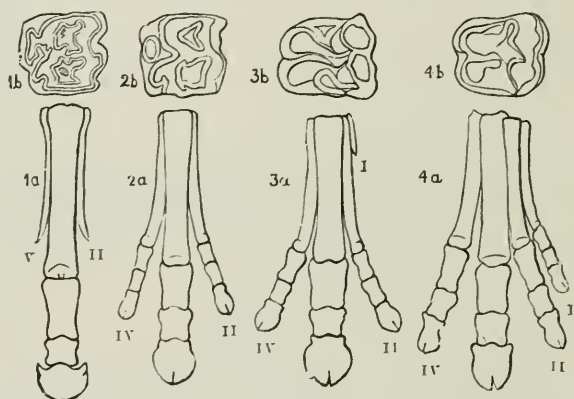


FIG. 13.—Diagram showing the gradual loss of toes in the fore foot (a) and increase of complexity in the grinding teeth (b) of successive Horse-like Ungulata from Europe—namely, *Hyracotherium* (4), *Anchitherium* (3), *Hipparion* (2), and *Equus* (1); much reduced, but not showing relative size. Digits numbered I, II, IV.

North America, by slightly smaller animals, which are already horses in every essential respect, but have a pair of complete though diminutive side-toes on each foot. The Old World species belong to the genus *Hipparion* (Fig. 13, 2), and remains are exhibited from India, Persia, Samos, Greece, Italy, Germany, France, Spain, and the Red Crag of England. Complete legs, skulls, and other remains from Pikermi, Greece, are especially noteworthy in Pier-case 10. *Hipparion* has also been recorded from North America, where it immediately succeeds another three-toed horse, *Protohippus*, which is not represented in the collection.

Table-case
5.

The Miocene and Oligocene horse-like animals, both in Europe and in North America, are still smaller than the

Pliocene *Hipparion*. The grinding teeth in these animals are less deepened than in the last-mentioned genus, those of the earlier forms being indeed quite low-crowned and only fit for comparatively succulent vegetation. The side-toes tend to become larger and touch the ground as they are traced back in geological time. Typical remains of *Anchitherium* (Fig. 13, 3), from the Middle Miocene of Europe, and of *Mesohippus*, from the Oligocene of North America, are exhibited in Table-case 5.

The Eocene horse-like animals are still smaller than the later forms just mentioned, and their immediate connection with the horses would be difficult to recognise if all the links of Oligocene and Miocene age remained unknown. A plaster

Table-case 5.

Pier-case 9.
Table-case 5.

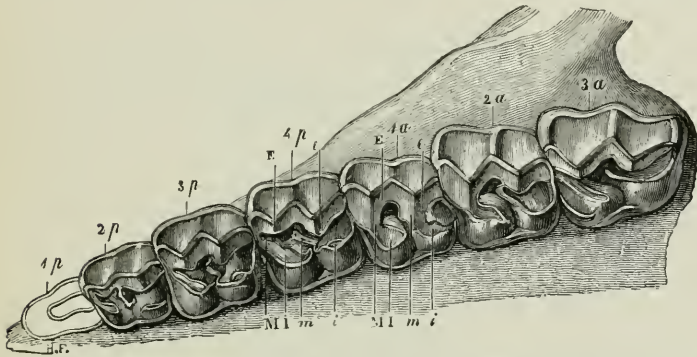


FIG. 14.—Left upper teeth in maxilla of *Palæotherium crassum*, from the Upper Eocene Gypsum of Montmartre, Paris; three-quarters nat. size. 1a-3a, three molars; 1p-4p, four premolars; other letters indicate various tooth-cusps. (After A. Gaudry.)

cast of *Protorohippus venticolus* from the Wind River Formation of Wyoming, U.S.A., exhibited in Pier-case 9, affords a good idea of one of these animals about as large as a fox; and there are actual remains both of this and of the closely related *Hyracotherium* (Fig. 13, 4) from the Lower Eocene of the London Basin in Table-case 5. The ridges on the grinding teeth are more or less subdivided into tubercles; the neck is not very mobile; the fore limb has a complete and separate ulna, allowing some power of twisting, and there are four spreading toes; the hind limb has only three complete toes. *Palæotherium* and *Lophiodon* are allied genera from the Eocene of Europe, and comprise some species as large as rhinoceroses. *Palæotherium* (Figs. 14, 15) was first

Pier-case 9. discovered in the Paris Gypsum and studied by Cuvier, who rightly recognised many points of resemblance in it to the living tapirs, and published in 1825 the accompanying restored sketch of the animal (Fig. 15). As already mentioned, in fact, all the Eocene Perissodactyla are adapted for dwelling in marshes, like the tapirs; and they are preceded at the base of the Eocene by five-toed animals, like *Phenacodus* (Pier-case 9 and Table-case 5), which is one of the small-brained Condylarthra to be noticed below (p. 48).

The gradual changes in the feet, teeth, and skulls of the horse-like hoofed animals, as they are traced through the Tertiary period, are also illustrated by a series of plaster

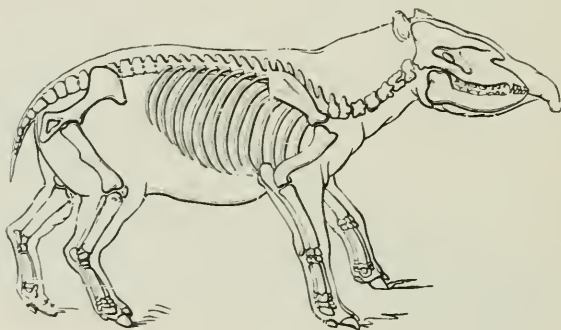


FIG. 15.—Restoration of the skeleton and outline of the body of *Palæotherium magnum*, from the Upper Eocene; about one-thirtieth nat. size. (After Cuvier.)

casts and models arranged in a Case in the Gallery of Domesticated Animals behind the Great Hall.

Pier-case 9. The distribution of the tapirs or **Tapiridæ** in the existing world is very curious, and has only been explained by the study of fossils. They occur exclusively in the Malayan region of Asia, and in the tropical parts of America, not in any intervening country. In the Pliocene and Miocene periods, however, they ranged over most of Asia, Europe, and North America. They are thus a vanishing race, which has survived only at the two extremities of its former area of distribution. A fine palate of *Tapirus priscus*, from the Lower Pliocene of Eppelsheim, Hesse-Darmstadt, is exhibited in Pier-case 9. There are also isolated teeth of *Tapirus* from China and from the English Red Crag.

SUB-ORDER 2.—**Ancylopoda.**

During part of the Miocene and Pliocene periods in **Pier-case 9**. Europe, Asia and North America, there lived some large three-toed quadrupeds which had grinding teeth much like those of the Titanotheriidae and exhibited many resemblances to the Perissodactyla in general, but differed from all known Ungulata in the peculiar structure of the feet. In these animals the weight of the body when walking seems to have been mainly supported by the outer side of the twisted foot, while the phalanges of each digit curve upwards on highly-developed pulley-joints and end in a cleft, pointed, claw-shaped bone—an arrangement suggesting the name Ancylo-

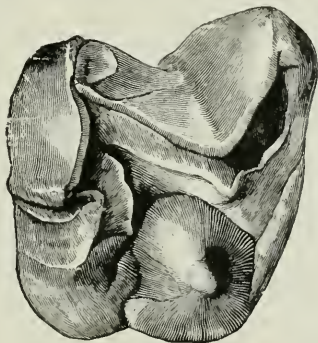


FIG. 16.—View of grinding surface of third right upper true molar tooth of *Chalicotherium sinense*, from the Pliocene of China; nat. size. (**Pier-case 9**.)

poda (“curve-feet”) for the sub-order. The feet, indeed, are so much like those of the extinct ground-sloths of America and the existing pangolins (*Manis*) of the Old World, that the isolated toe-bones were referred to the Edentata until a nearly complete skeleton of one genus (*Macrotherium*) was found in the Miocene of France. Among the remains exhibited in **Pier-case 9** may be particularly noted a toe of *Macrotherium* from the Middle Miocene of Sansan, France; a toe of *Ancylotherium* (lacking claw) from the Lower Pliocene of Pikermi, Greece; and teeth of *Chalicotherium* (Fig. 16) from the Pliocene of India and China.

SUB-ORDER 3.—**Artiodactyla.**

Pier-cases
11-19.
Table-cases
6-10.

In another group of hoofed marsh-dwellers of the Eocene period the weight of the body soon became supported mainly by two of the middle toes (nos. III, IV), which grew to be of equal size. Hence the Artiodactyla or even-toed hoofed animals. In some cases, even before the close of the Eocene period, the side-toes had dwindled and practically disappeared, while the basal pieces (or meta-

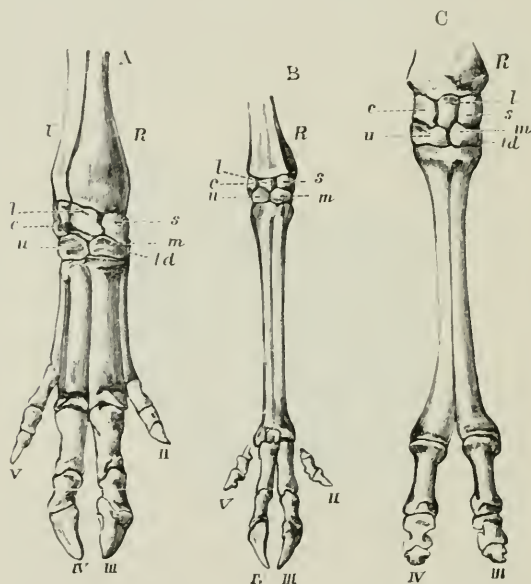


FIG. 17.—Skeleton of Fore foot of three existing Artiodactyl or Even-toed Ungulata—namely, Pig (A), Deer (B), and Camel (C), much reduced in size. R, radius; U, ulna; c, cuneiform; l, lunar; s, scaphoid; u, unciform; m, magnum; td, trapezoid; II, III, IV, V, the several digits. (From Flower's "Osteology of the Mammalia.")

podium) of the pair of supporting toes became fused together, thus producing the appearance of a "cloven hoof." As the successive Tertiary periods followed, the SUINA (pigs, peccaries, and hippopotamus) alone retained their four separate toes; the TYLOPODA (camels and llamas) gradually lost their side-toes, while the bases of their middle toes still remained imperfectly fused at their lower end; the TRAGULINA (chevrotains) and PECORA (giraffes, deer, sheep, and cattle) also lost their side-toes more or less completely, and

the "cloven hoof" arrangement attained perfection, working on pulley-joints. These modifications of the feet are illustrated in Fig. 17.

Except that they have a relatively large, highly-developed brain, and curiously modified front teeth which grow throughout life, the **Hippopotamidæ** are very little different from some of the early Eocene Artiodactyla. They have indeed completely retained the aquatic and marsh-dwelling habit. Although the hippopotamus is at present confined to Africa, it also ranged over a large part of Europe and Asia in the Pleistocene period. Remains of fine animals, which cannot be distinguished by their bones and teeth from the existing African *Hippopotamus amphibius*, are not uncommon in England even so far north as Yorkshire. A large mandible from the valley of the Cam at Barrington, near Cambridge, is exhibited in Pier-case 11. In this and the adjacent Table-case 6 there are also teeth and bones of the same species from the Thames deposits, from Bedford, Essex, Oxfordshire, and Suffolk, and from the Norfolk Forest Bed. A mandible and other bones from the Upper Pliocene of Mont Perrier, Puy-de-Dôme, France, besides remains from the Arno valley in Italy, are likewise shown in Pier-case 11. *H. pentlandi* is a smaller species, whose bones and teeth occur in such enormous accumulations in the caverns of Sicily, that they were dug out and exported from Palermo for many years to be calcined for use in sugar-refining. Remains of the same small species are shown from the caverns of Malta; and there is a still more pigmy animal, *H. minutus*, whose bones and teeth were found by Miss D. M. A. Bate in such great abundance in the caverns of Cyprus, that it has been possible to reconstruct the skeleton in Pier-case 11. The remains had probably been washed into the caverns by streams and floods. Another small species, *H. madagascariensis*, of which a reconstructed skeleton is exhibited in Pier-case 11, seems to have been quite common in Madagascar at a late geological period. No hippopotamus now lives in Madagascar, and the bones and teeth of this small species exhibit so many variations, that it doubtless had a severe struggle for existence. Although the hippopotamus is now extinct in India, several species lived there in the Pliocene and Pleistocene periods, as shown by the Cautley Collection in Pier-case 12 and Table-case 6 (Fig. 18). The Miocene and earlier representatives of the family still remain to be discovered, most likely in Africa.

Pier-cases
11, 12.
Table-case
6.

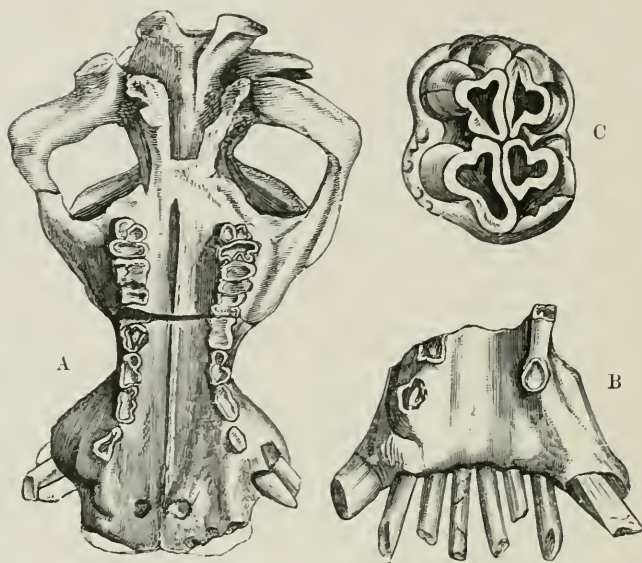


FIG. 18.—Palatal view of skull (A), symphysis of lower jaw (B), and grinding surface of molar tooth (C) of an extinct Hippopotamus (*Hippopotamus sivalensis*), from the Lower Pliocene of the Siwalik Hills, India; A and B one-eighth nat. size, C one-half nat. size. (Pier-case 12.)

Pier-case
13.

The true pigs, or **Suidæ**, have always been confined to the Old World, and the oldest known species is *Sus chæroides*, from the Middle and Upper Miocene of France and Italy.

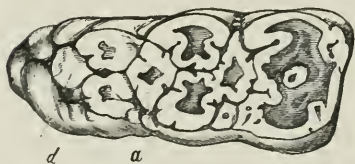


FIG. 19.—Grinding surface of third right lower true molar tooth of an existing Pig (*Sus cristatus*), from India; nat. size. a, d, middle columns of talon of tooth.

Among the fossil remains of this family in Pier-case 13 may be noticed skulls, jaws, and teeth of the wild boar from England and Ireland; some fine skulls and jaws of the large *Sus erymanthius*, from the Lower Pliocene of Pikermi, Greece; pieces of skulls and jaws of other extinct species from the Lower

Pliocene of the Siwalik Hills, India; and similar remains of *Hippohyus sivalensis*, a pig from the Siwalik Formation with deepened grinding teeth rendered very effective by the crimping of their enamel.

Nothing is known of the direct ancestors of the American peccaries (**Dicotylidæ**). Remains of the typical *Dicotyles* from the caverns of Brazil are exhibited in Table-case 7.

Among earlier animals allied to the pigs, the large *Elotherium*, from the Oligocene and Miocene of Europe and North America, is especially remarkable. As shown by remains in Pier-case 13, it had only two toes, with the merest rudiment of the outer toes. *Listriodon*, from the Miocene of Europe and India, has a skull like a pig, but grinding teeth with cross-ridges like those of a tapir (Table-case 7). *Hyootherium* is provided with large upper canine teeth (Table-case 7). *Chæropotamus* is represented in the same Case by jaws and teeth from the Upper Eocene of the Isle of Wight and of France.

In these early allies of the pigs the molar teeth are nearly square and bear regularly arranged cusps or ridges. In some of them the tooth-cusps tend to become crescent-shaped, and hence make an approach to the trenchant crescentic ("selenodont") cusps of the teeth in the higher Artiodactyla which chew the cud ("ruminants"). One family, that of the **Anthracotheriidæ**, with molar teeth in this condition, arose in the Upper Eocene and was represented during the Oligocene period by many moderately large species, which ranged over the greater part of the northern hemisphere. These were stoutly-built animals, some probably much resembling the pigs in outward aspect, others more nearly allied to the hippopotamus. All of them have four or five separate toes. *Anthracotherium* ("coal beast") itself, which is well represented in Table-case 7, is so called from the circumstance that its remains were first discovered in the lignite or brown-coal of Savoy. It is chiefly found in the Oligocene of Europe, but also seems to occur in the corresponding deposits in Dakota, U.S.A., while a few teeth have been assigned to it from the Lower Pliocene Siwalik Formation of India. The European *A. magnum* must have been as large as a rhinoceros. *Ancodus* or *Hypopotamus* is another genus, of which the detached teeth (Fig. 20) are



FIG. 20.—Grinding surface of third right upper true molar tooth of *Ancodus* [*Hypopotamus*] *bovinus*, from the Oligocene of Hempstead, Isle of Wight; nat. size. (Table-case 7.)

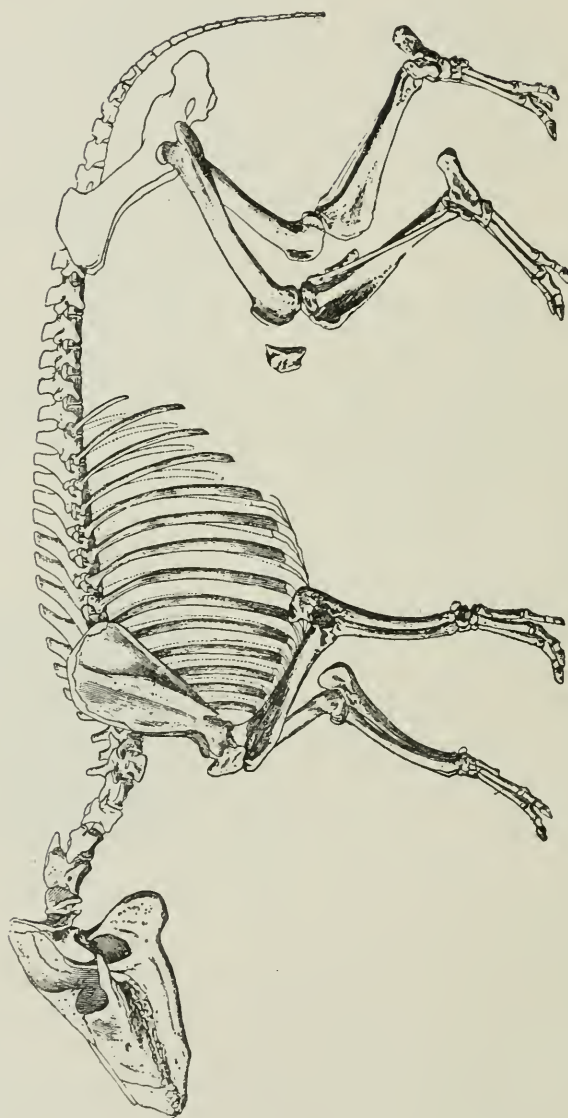


FIG. 21.—Skeleton of *Anceodus* [*Hypopotamius*] *brachyrhynchus*, from the Oligocene of Dakota, U.S.A.; one-tenth nat. size. (After W. B. Scott.)

among the commonest fossils from the Hempstead Beds of the Isle of Wight (Table-case 7). Several skulls have been obtained from the Oligocene of Ronzon, France, and nearly complete skeletons from the Oligocene of Dakota, U.S.A. (Fig 21). *Brachyodus* occurs not only in Europe, but also in the Miocene of Egypt. *Merycopotamus* is found in the Lower Pliocene Siwalik Formation of India and Burma, and various skulls and jaws are exhibited in Pier-case 13 and Table-case 7.

The actual fore-runners of the ruminants are placed in Table-case 8. They show (1) the gradual acquisition of the typical "selenodont" molar teeth, (2) the beginning of the



FIG. 22.—Right upper teeth of *Anoplotherium cayluxense*, from the Oligocene Phosphorites of France; nat. size. (Table-case 8.)

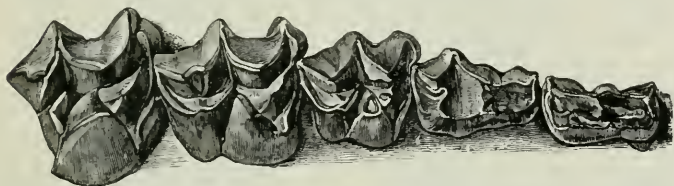


FIG. 23.—Right upper teeth of immature *Anoplotherium secundarium* from the Upper Eocene of Débruge, France; nat. size. (Table-case 8.)

gap ("diastema") between the front teeth and the back teeth, and (3) the gradual fusion of the bases of the two supporting toes. In the **Anoplotheriidae**, which are represented by *Anoplotherium* from the Upper Eocene and Oligocene of France, England, and Germany, the crescent-shaped tooth-cusps are low (Figs. 22, 23), the teeth are in a continuous row in the jaw without any gap, and there are three well-developed toes on each foot. The name *Anoplotherium* ("unarmed beast") was proposed by Cuvier, who first described the animal and was impressed by its lack of defensive weapons. The **Cænotheriidae** are smaller four-toed animals, from the European Oligocene and Lower

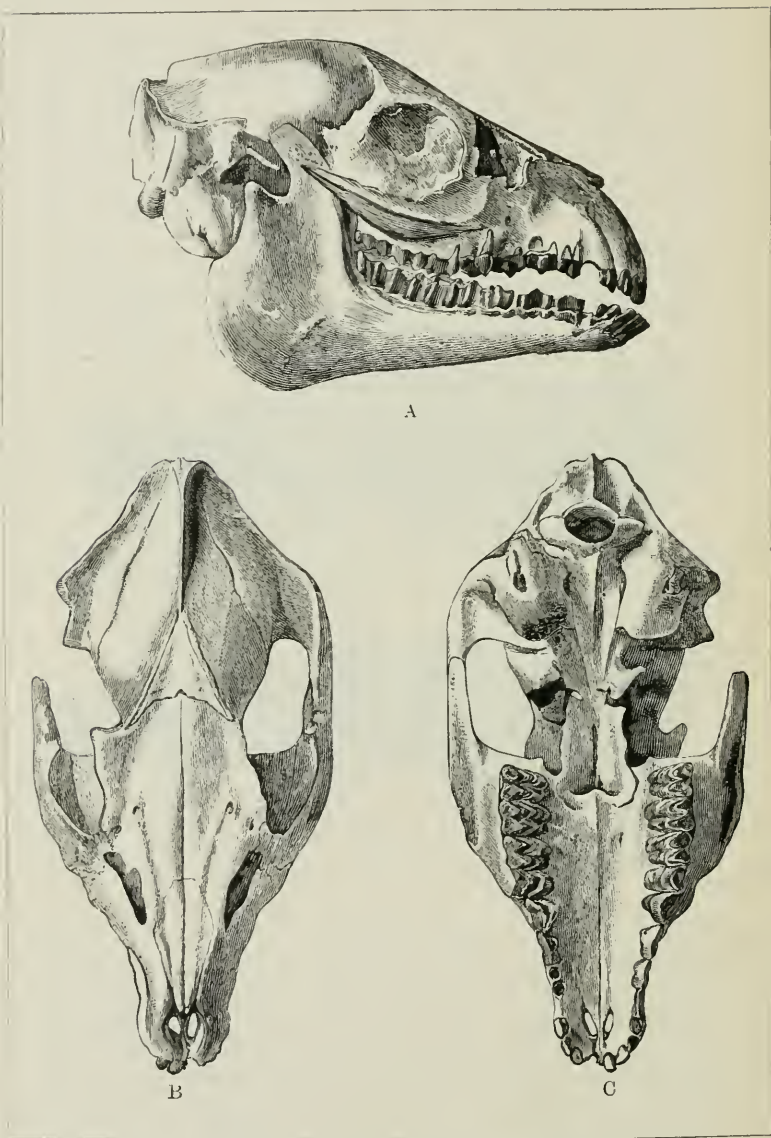


FIG. 24.—Skull of a primitive Ruminant (*Cænotherium filholi*), lateral (A), upper (B), and palatal (C) aspects, from the Oligocene Phosphorites of France; nat. size. (Table-case 8.)

Miocene formations, with deeper and more effective cusps on the molar teeth. As shown by numerous skulls of *Cænotherium* (Fig. 24), there is often a slight gap between its canine tooth and the premolars. The **Xiphodontidæ** are small two-toed animals from the Upper Eocene and Oligocene of England, France, and adjoining countries. *Dichodon* (Fig. 26) is a typical genus. The **Oreodontidæ** are more advanced ruminants ranging from the Upper Eocene to the Upper Miocene in North America. Skulls of *Oreodon* are exhibited, showing the lower canine tooth shaped like an incisor, while the foremost premolar is enlarged to usurp its function. The **Protoceratidæ** are an Oligocene North American family, in which the males bear at least two pairs of bony bosses (or "horns") on the head.

The nearest surviving relatives of these primitive ruminants are the little chevrotains, or **Tragulidæ**, which are now found only in the marshes of the Indo-Malayan region and western Africa. They never possess horns, but

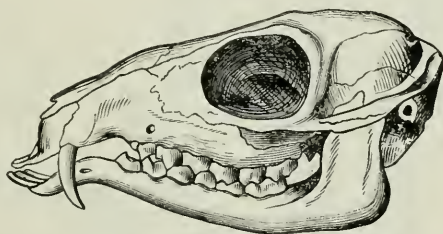


FIG. 25.—Side-view of skull and mandible of existing Chevrotain (*Tragulus javanicus*), from the Malayan region; reduced in size.

they agree with the giraffes, deer, and antelopes in having no upper front teeth (Fig. 25). *Prodremotherium*, from the Oligocene of France, is essentially similar to the living *Tragulus*, with the enlarged upper canine teeth. *Dorcatherium*, of which a fine skull is shown from the Lower Pliocene of Eppelsheim, Hesse-Darmstadt, is apparently identical with the living *Hyemoschus*.

Of the true ruminants the **Tylopoda**, or camels and llamas, seem to have originated in North America, where they can be traced back by fossils from the Pliocene and Miocene formations to a little gazelle-shaped creature of the Oligocene period, *Poebrotherium*. This small animal, of which a skull and limbs are exhibited in Pier-case 13, has a more nearly complete set of teeth than the modern camels,

Table-case
8.

Pier-case
13.

Pier-case
13.

and the basal bones in its feet are not entirely fused together. There were no camels later than the Pliocene period in

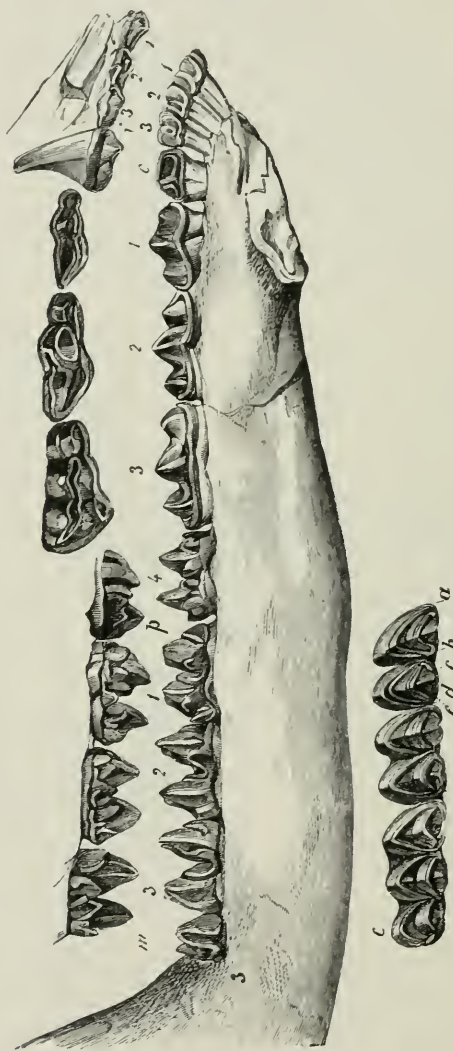


FIG. 26.—Teeth, premaxilla, and left mandibular ramus of a primitive Ruminant (*Dichodon cuspidatus*), from the Upper Eocene of Hordwell, Hampshire; nat. size. *i* 1-3, incisors; *c*, canine; *p* 1-4, premolars; *m* 1-3, molars. Upper premolars 1-3 are shown from the grinding surface, and lower molars 1-3 are shown from the same aspect below the jaw. (Table-case 8.)

North America. About that time, however, the representatives of the llamas wandered over the newly emerged Isthmus of Panama to South America, where they have

since flourished; while the true camels by some means reached Asia, as proved by numerous remains from the Siwalik Formation of India in Pier-case 13.

The giraffes, or **Giraffidæ**, have always been Old World quadrupeds. Though now confined to Africa, they also ranged over the greater part of Asia and southern Europe in the Lower Pliocene Period, as shown by fossils from China, India, and Greece in Pier-case 14. Even the long-limbed and long-necked *Giraffa* itself was in existence at that time, but it seems to have been less common than the antelope-shaped relatives of the okapi, which has only escaped extinction by retreating to the recesses of the Semliki forest. *Samotherium*, with a pair of horns only in the male (Fig. 27),

Pier-case
14.
Stand N.

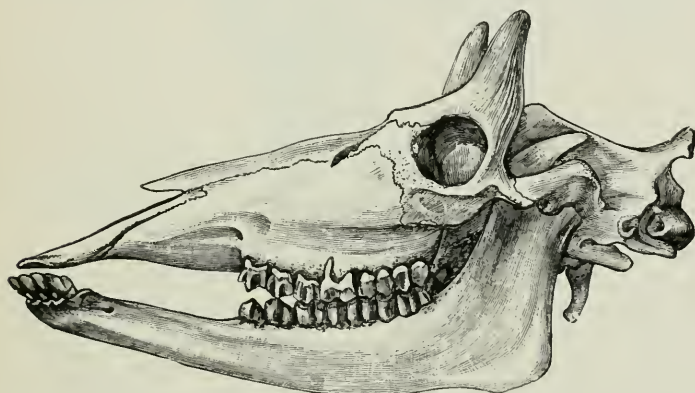


FIG. 27.—Skull and lower jaw of an extinct Okapi (*Samotherium boissieri*), from the Lower Pliocene of the Isle of Samos; one-sixth nat. size. (Pier-case 14.)

is known by many remains from the Lower Pliocene of Pikermi (Greece), the Isle of Samos, and Maragha (Persia), and it is scarcely distinguishable from the okapi. The original skull of this animal, described by Dr. Forsyth Major, is exhibited. *Helladotherium* is a larger and stouter relative, of which the female at least is hornless, represented by numerous fragments from Pikermi. *Sivatherium*, from the Siwalik Formation of India, is equally stout, and the male bears two pairs of horns, one simple pair being on the frontal bones, a large expanded pair further back (Fig. 28). The actual skull, detached horn-cores, limb-bones, and other remains of this animal are exhibited in Pier-case 14, while a restored model of the head is mounted on

Pier-case 14. a separate pedestal (N). *Hydaspitherium* and *Bramatherium*
Stand N. are contemporary genera from the Siwalik Formation of India.



FIG. 28.—Front view of skull of an extinct Giraffe-like animal (*Sivatherium giganteum*), from the Lower Pliocene of the Siwalik Hills, India; one-thirteenth nat. size. (Stand N.)

Pier-case 15. The deer, or **Cervidæ**, were as widely distributed in the
Table-cases 9, 10. Pleistocene period as at the present day, and some of the
Stands Q, R. European species at that time possessed the largest known antlers. The great Irish deer, *Cervus giganteus*, is especially remarkable in this respect, the antlers of the male often measuring slightly more than nine feet across and exhibiting a considerable expansion. This animal (Fig. 29) is sometimes termed an elk, but the shape of the nose and the presence of a brow-tyne on each antler show that it is a true deer. The male alone bears antlers, and reconstructed skeletons of both sexes from Irish peat-bogs are mounted on stands Q, R, in the middle of the Gallery. Several skulls and antlers, to show their variability, are placed on the top of the Pier-cases, and there are also skulls with jaws in Pier-case 15. The remains are especially common in the marl at the bottom of the Irish peat-bogs, where the animals seem to have perished when the present bogs were either swamps or lakes; and there is evidence that they were not all exterminated in Ireland until comparatively late prehistoric times. During recent years several specimens have been dug up in the Isle of Man, and these probably date back to the time before the Irish Sea was formed. During the Pleistocene period numerous

varieties of the species seem to have ranged over the greater part of Europe. Jaws from the English caverns and river-deposits are exhibited in Table-case 10, and there is a male skull (lacking antlers) of the Italian race, *Cervus euryceros*, from Lombardy, in Pier-case 15. A skull with incomplete

Pier-case
15.
Table-cases
9, 10.
Stands Q,
R.

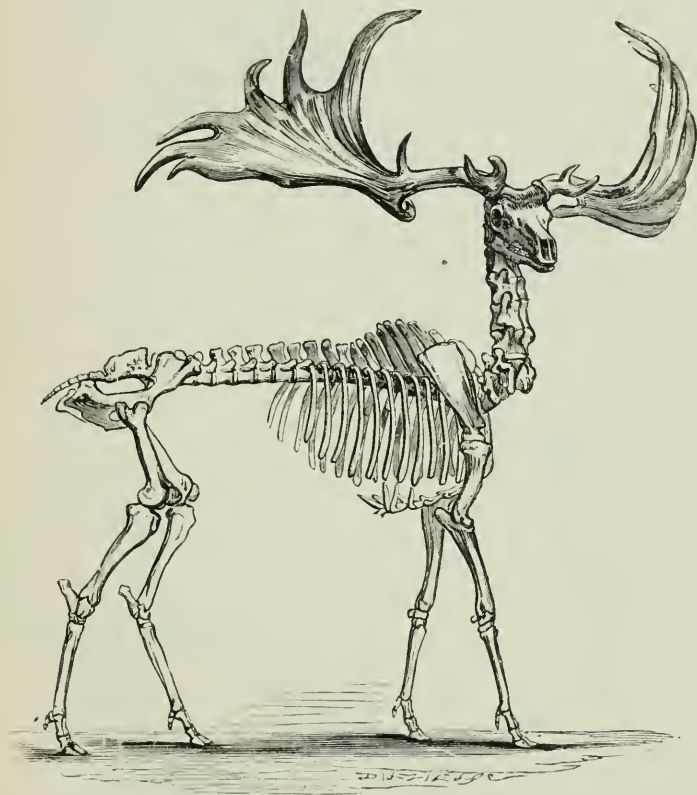


FIG. 29.—Skeleton of male Irish Deer (*Cervus giganteus*), from shell marl beneath a peat-bog, Ireland; about one-thirtieth nat. size. (Stand Q.)

antlers from Russia is mounted on the top of Pier-case 11. The Pleistocene representatives of the common stag or red deer, *Cervus elaphus*, in western Europe were sometimes of gigantic size, as shown by fragments of antlers from Kent's Cavern in Table-case 10. Moderately large antlers from river-deposits and lake-deposits in the British Isles are

Pier-case
15.
Stands Q,
R.

mounted in Pier-case 15 and on blocks fixed to various pillars in the Gallery (Fig. 30). A specially fine pair of



FIG. 30.—Antler of Red Deer (*Cervus elaphus*), one of a pair dredged from the River Boyne at Drogheda, Ireland; one-tenth nat. size. (Pillar between Pier-cases 16, 17.)



FIG. 31.—Skull and antlers of Reindeer (*Rangifer tarandus*), from Bilney Moor, East Dereham, Norfolk. (After Owen.)

antlers from a deposit of tufa near Bakewell, Derbyshire, is placed in a case on the top of Pier-case 16. There are also associated remains of an extinct fallow deer (*C. browni*) in Pier-case 15, and of the roebuck (*Capreolus caprea*) in Table-case 10. The reindeer (*Rangifer tarandus*) during the Pleistocene period wandered as far south as the Pyrenees and Alps, and there are fine antlers (Fig. 31) from

Pier-case
15.
Table-case
10.

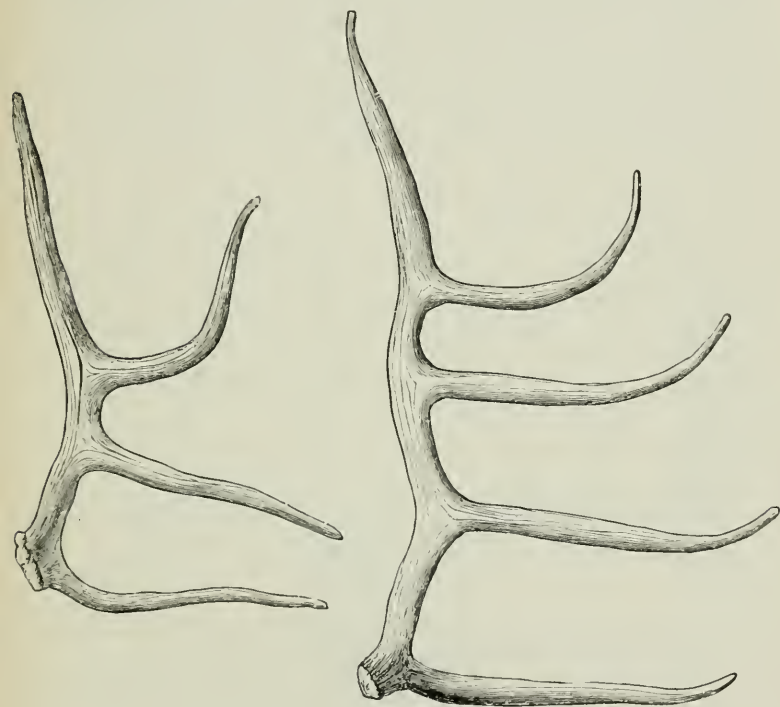


FIG. 32.—Antlers of fifth and sixth years of "*Cervus*" *tetraceros*, from the Upper Pliocene of Peyrolles, France; one-tenth nat. size. (Pier-case 15.)

the Thames valley and other English localities in Pier-case 15. This animal is said to have survived in Caithness so late as the twelfth century, but experiments have shown that even when imported and allowed suitable feeding ground it is unable to exist in that country now. The elk (*Alees machlis*) also lived in Pleistocene Britain as far south as the Thames valley (see Pier-case 15 and the pillar between

Pier-case
15.

Pier-case
15.

Pier-cases 12, 13). A large extinct species, *Alces latifrons*, flourished here at the beginning of the Pleistocene period, its remains occurring with those of several extinct kinds of deer in the Norfolk Forest Bed. The Savin Collection of antlers of deer and elk from this deposit, near Cromer, is exhibited in Pier-case 15.

Antlers of deer related to *Cervus* occur first in the Upper Pliocene of Europe, and among them may be noted those of the so-called *Cervus tetruceros* from France (Fig. 32). A series of antlers of this animal, representing individuals of different ages, is mounted in the upper part of Pier-case 15. It will be noticed that the number of tynes on the antlers increases with age, as in the common stag (Fig. 33, C, D) and in all

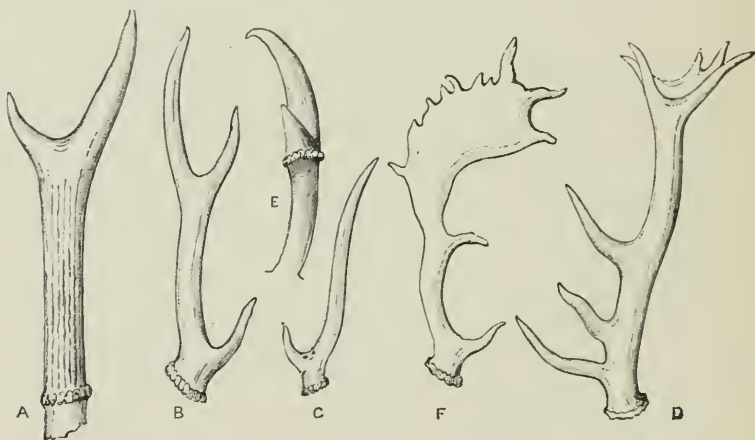


FIG. 33.—Antlers of various Deer, much reduced in size. A. *Cervulus dicranoceros*; Lower Pliocene. B. *Cervus pardinensis*; Upper Pliocene. C, D. *Cervus elaphus*, second year and adult; Pleistocene and Recent. E. Bony pedicle and antler of existing Muntjak, *Cervulus muntjac*. F. Existing Fallow Deer, *Cervus dama*.

Table-case
9.

other deer with elaborate antlers; but the complexity and size of the Upper Pliocene antlers never equal those of some of the Pleistocene antlers. The Lower Pliocene and Upper and Middle Miocene deer-antlers are still smaller and simpler, as shown by examples in Table-case 9 (Fig. 33, A). The Lower Miocene and Oligocene deer, as represented by *Amphitragulus* from France and Germany, are small and destitute of antlers, like the living musk-deer (*Moschus*) of Asia. The geological history of the antlers in the race of deer thus

corresponds exactly with the life-history of the antlers in any individual modern deer—at first there are no antlers, then single prongs, then increasing complexity until the maximum is reached in full maturity.

Table-case
9.

The antelopes, sheep and oxen, or **Bovidæ**, attain their greatest development at the present day. They are essentially an Old World family, and do not appear to have reached America until the close of the Pliocene period. The present distribution of many species, however, is quite limited, compared with their range in the Pleistocene period. The Saiga antelope (*Saiga tatarica*), now living on the Siberian steppes, then wandered as far west as England; and a frontlet from the Thames deposits at Twickenham is exhibited in Pier-case 16. The European bison (*Bison bonasus*), now surviving in Lithuania and the Caucasus, ranged throughout the greater part of Europe and even to the Arctic regions. Fine frontlets from England and various Arctic localities are arranged in Pier-case 16. The American bison and allied species flourished in the New World. The musk-ox (*Oribos moschatus*), now confined to the extreme north, came south with the reindeer as far as the Pyrenees; and there are typical remains from the Thames and Severn Valleys in Pier-case 16. The urus (*Bos primigenius*), which was seen by Cæsar in historic times in the Hercynian forest, was common

Pier-cases
16-19.

Pier-case
16.



FIG. 34.—Skull of the Urus (*Bos primigenius*), from the British Pleistocene; one-fourteenth nat. size. (Pier-case 18.)

in the Pleistocene period throughout Europe (Fig. 34). Sir Antonio Brady's collection of the remains of this ox from

- Pier-case 18. Ilford, Essex, is placed with other British specimens in Pier-case 18. The animal seems to have become extinct in the British Isles long before the dawn of history, and it was succeeded by the imported Celtic short-horn (*Bos longifrons*), of which numerous remains are shown in Pier-case 19. The latter species is supposed to be the ancestor of the existing small Welsh and Scottish cattle.

- Pier-case 19. Skulls of primitive cattle collected chiefly by Colonel Sir Proby T. Cautley in the Lower Pliocene of the Siwalik Hills, India, are exhibited in Pier-case 17. The females of some species seem to have been hornless. Skulls of *Bubalus* from the Pleistocene of the Narbada Valley, India, are also placed in Pier-case 19. The horn-cores of one specimen have a span of over six feet.

- Pier-case 16. Goats and sheep are almost unknown among fossils, but a few fragments are shown in Pier-case 16.

Skulls and other remains of extinct antelopes, chiefly from the Lower Pliocene of Greece, the Isle of Samos, Persia, and India, are arranged in Pier-case 16. *Palæorcas*, *Tragoceros*, and *Criotherium* are especially noteworthy. Among the remains of gazelles, there is a horn-core (*Gazella anglica*) from the Lower Pliocene Coralline Crag of Suffolk.

SUB-ORDER 4.—**Amblypoda.**

- Pier-case 21. From some of the preceding observations it is evident that most of the existing mammals can be traced back by a series of gradations to small five-toed creatures, with an insignificant brain-capacity, at the beginning of the Eocene period. A few of the herbivorous mammals of the primitive grade never advanced beyond this lowly condition, but grew to unwieldy proportions, like those of a rhinoceros or elephant. Their head became large, but the brain itself always remained ridiculously small (Fig. 35A). Their limbs became massive pillars, with little five-toed stumpy feet (Fig. 35B, C), merely to support the overgrown body. They are appropriately named Amblypoda ("blunt feet") in allusion to the latter feature. They lived only during the Eocene period, but they seem to have been very widely distributed, their remains having been found in Europe and North America, and perhaps South America.

- Pier-case 21. The first described fragment of an Amblypod is a piece of mandible named *Coryphodon cocænus* by Owen in 1846, probably from the London Clay, but dredged off the Essex

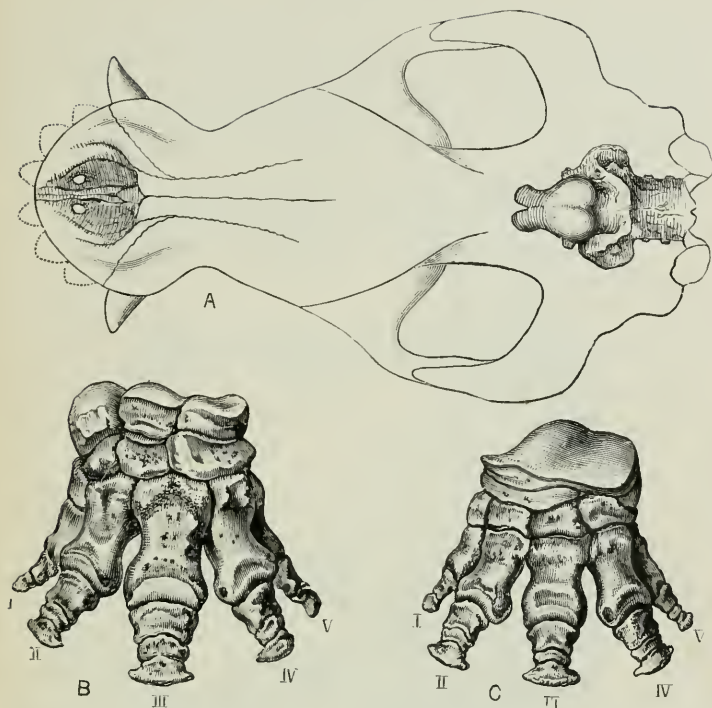


FIG. 35.—Outline of upper view of skull (A) to show size of brain, with fore (B) and hind (C) feet, of an Amblypod (*Coryphodon hamatus*), from the Lower Eocene of Wyoming, U.S.A.; A one-fifth, the others one-third nat. size. (After O. C. Marsh.)

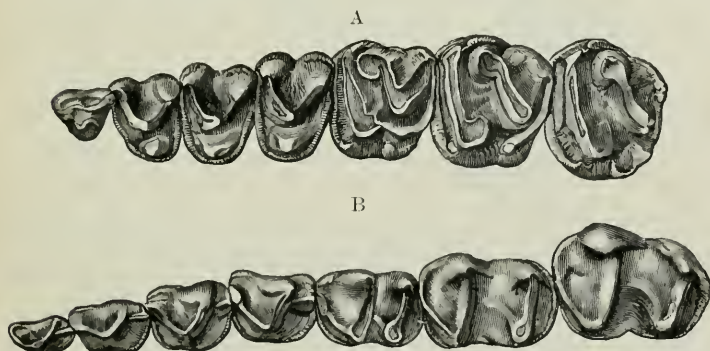


FIG. 36.—Left upper (A) and lower (B) grinding teeth of *Coryphodon hamatus*, from the Lower Eocene of Wyoming, U.S.A.; one-half nat. size. (After O. C. Marsh.)

Pier-case 21. coast near Harwich. It is exhibited in Pier-case 21. Other remains of *Coryphodon* are known from the Lower Eocene of England and France, and nearly complete skeletons have been found in rocks of the same age in North America. The grinding teeth (Fig. 36) are adapted for succulent food, and

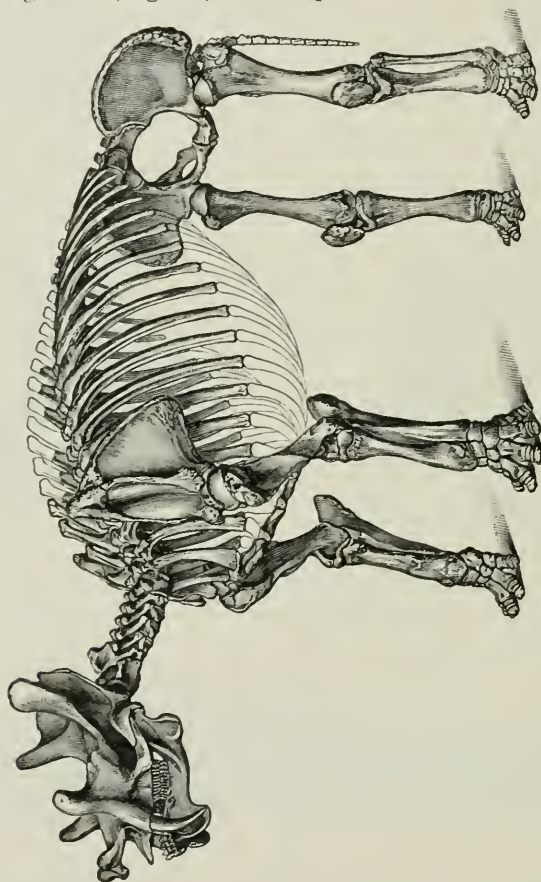


FIG. 37.—Skeleton of an Amblypod (*Tinoceras ingens*), from the Middle Eocene of Wyoming, U.S.A.; one-thirtieth nat. size. (After O. C. Marsh. See Case U.)

the canine teeth are only slightly enlarged. All the species are hornless, and some seem to have attained a body-length of about six feet.

The Middle Eocene Amblypoda, hitherto discovered only in North America, are curiously horned, and commonly known as Dinocerata ("terrible horns"). A papier maché copy of a complete skeleton of *Dinoceras* (or *Uintatherium*)

mirabile from the Bridger Formation of Wyoming, presented by Professor O. C. Marsh, is mounted in a special Case marked U. A plaster cast of a skull of *Tinocras ingens* (Fig. 37) is placed beneath it; and a series of brain-casts to show the relatively small size of its brain is arranged in front. The skull bears three pairs of bony prominences, which increase in size backwards, and seem to have been

Case U.



FIG. 38.—Skull and lower jaw of *Arsinoitherium zitteli*, from the Upper Eocene of the Fayum, Egypt; one-twelfth nat. size. (Case S.)

covered merely with skin. These bony horns and the brain-case are almost solid, with very few cavities. The upper canine teeth are much enlarged, and are protected by long flanges depending from the mandible.

SUB-ORDER 5.—**Barypoda.**

Arsinoitherium, from the Upper Eocene of the Fayum, Egypt, has a relatively larger brain than the Amblypoda,

Wall-case
22.
Case S.

Wall-case
22.
Case S.

and represents a group allied both to the latter and to the Hyracoidea. A skull and mandible (Fig. 38) and an immature skull are mounted in Case S, and numerous remains are arranged in Wall-case 22. The teeth are deepened for the effective grinding of dry vegetation, while the canine teeth are quite small and crowded between the continuous regular series of premolars and incisors. There is one pair of small bony horn-cores above the eye, and there is an immense pair of horn-cores in front, which seem to be the excessively enlarged nasal bones. These horn-cores, like the rest of the large skull, are formed by a mere hollow shell of bone, and the grooves for blood-vessels in their surface suggest that they were originally covered with a sheath of true horn.

SUB-ORDER 6.—**Hyracoidea.**

Pier-case
21.

The small existing hyraxes of Africa, Arabia, and Syria, are the scarcely altered survivors of a group of Eocene hoofed mammals allied to the Amblypoda and Condylarthra. They seem to have originated in the African region, and jaws of one hyracoid (*Megalohyrax eocœnus*), as large as a donkey, are shown from the Upper Eocene of the Fayun, Egypt (Pier-case 21). *Pliohyrax*, from the Lower Pliocene of Pikermi (Greece), the Isle of Samos, and Maragha (Persia), must have been equally large.

SUB-ORDER 7.—**Condylarthra.**

Pier-case
21.

These are the small primitive five-toed hoofed animals of the Eocene period, which might serve very well for the ancestors of all later Ungulata. They occur both in Europe and North America, but the most satisfactory specimens have been found in the latter country. *Phenacodus* (Figs. 39,40), of which a plaster cast of a nearly complete skeleton is exhibited in Pier-case 9, is a typical example. Fragments of jaws of Condylarthra are also shown in Pier-case 21.

SUB-ORDERS 8-10.—**Typotheria, Toxodontia, and Litopterna.**

Pier-cases
20, 21.
Table-case
11.

South America seems to have been separated from the rest of the world during the greater part of the Tertiary period, and its indigenous hoofed mammals, commonly

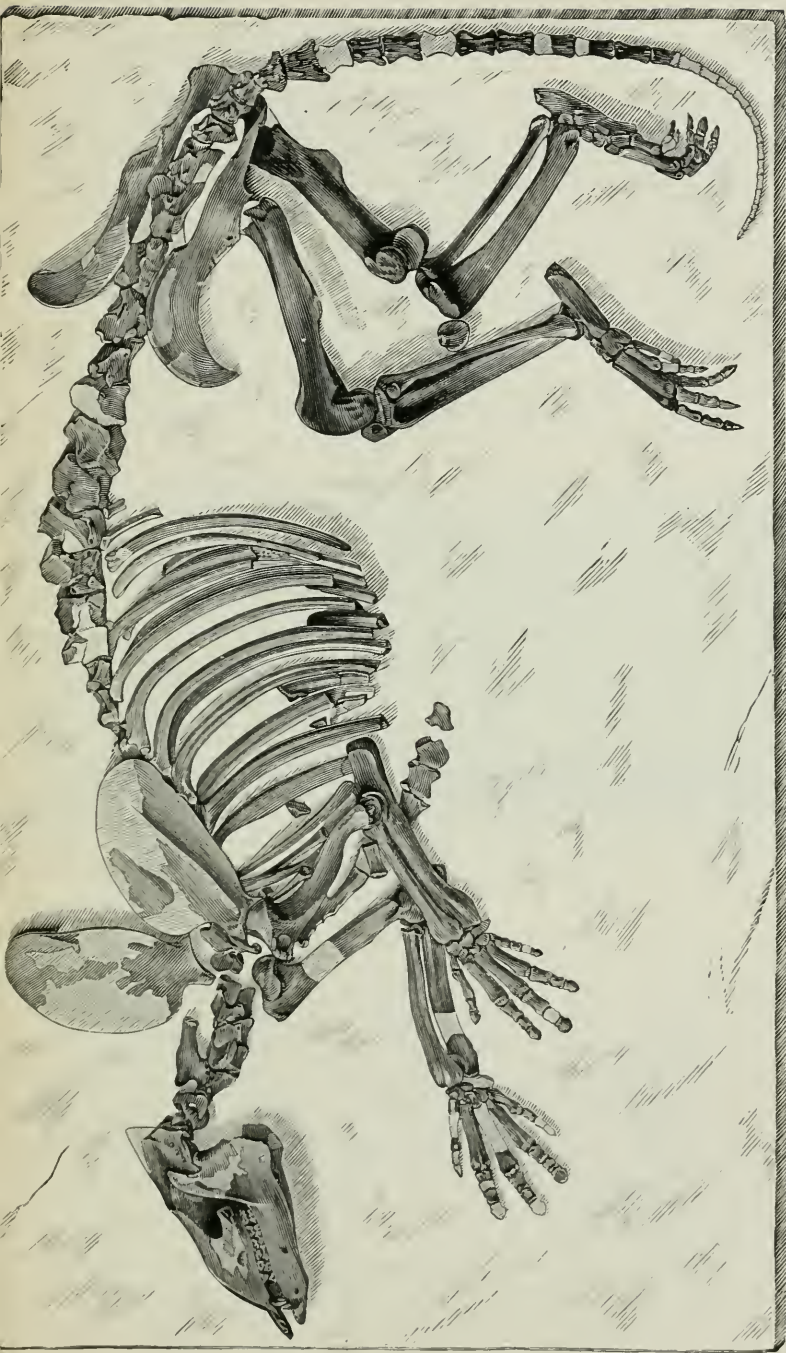


FIG. 39.—Skeleton of a primitive hoofed Mammal (*Placodotus primævus*), from the Lower Eocene of Wyoming, U.S.A., about one-seventh nat. size. (Pier-case 9.)

Pier-cases
20, 21.
Table-case
11.

arranged in three sub-orders, are nearly all different from any found elsewhere. The South American llamas, deer, peccaries, tapirs, extinct horses and mastodons, of course, are not indigenous, but passed south over the newly emerged isthmus of Panama or other land-bridge at the beginning of the Pliocene period.

Pier-case
20.

Some of the earliest known South American hoofed mammals, such as *Pyrotherium*, are very little different from the Amblypoda and Condylarthra of the northern hemisphere. Plaster casts of jaws, teeth, and feet of *Pyrotherium* from Patagonia are exhibited in Pier-case 20. The later forms, however, are peculiar in the folding and complication of their often persistently-growing teeth; also in the structure

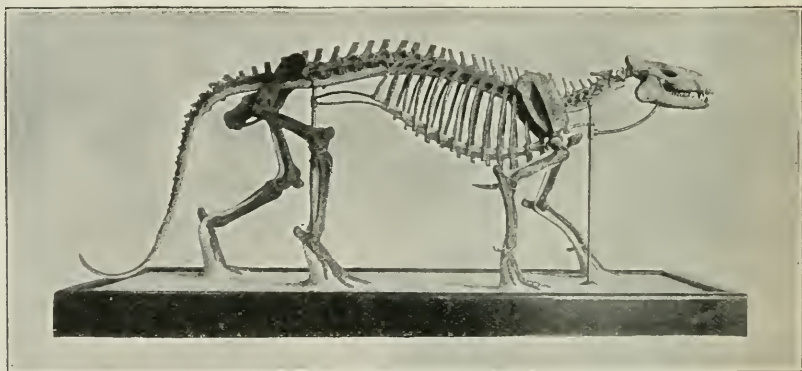


FIG. 40.—Skeleton of *Phenacodus primavus*, as now mounted in the American Museum of Natural History, New York.

Pier-cases
20, 21.
Case T.

of their feet when they begin to become plain-dwellers and mimic the rhinoceroses and horses of the rest of the world. *Toxodon* (Fig. 41) is an especially remarkable beast with ever-growing powerful cutting and grinding teeth, well seen in actual specimens in Pier-case 21. A plaster cast of a reconstructed skeleton of this large animal from the Pampa of the Argentine Republic, now in the La Plata Museum, is mounted in a special Case marked T. When alive it must have been shaped much like the contemporaneous rodents and giant armadillos. It was preceded in time by *Nesodon* and other smaller kinds of which remains are shown in Table-case 11. *Macrauchenia*, also from the Pampa Formation, was a large animal shaped like a llama, but with three

separate toes on each foot. In this hoofed quadruped the lower end of the ulna and fibula has not disappeared, as is

Pier-case
20.
Case T.

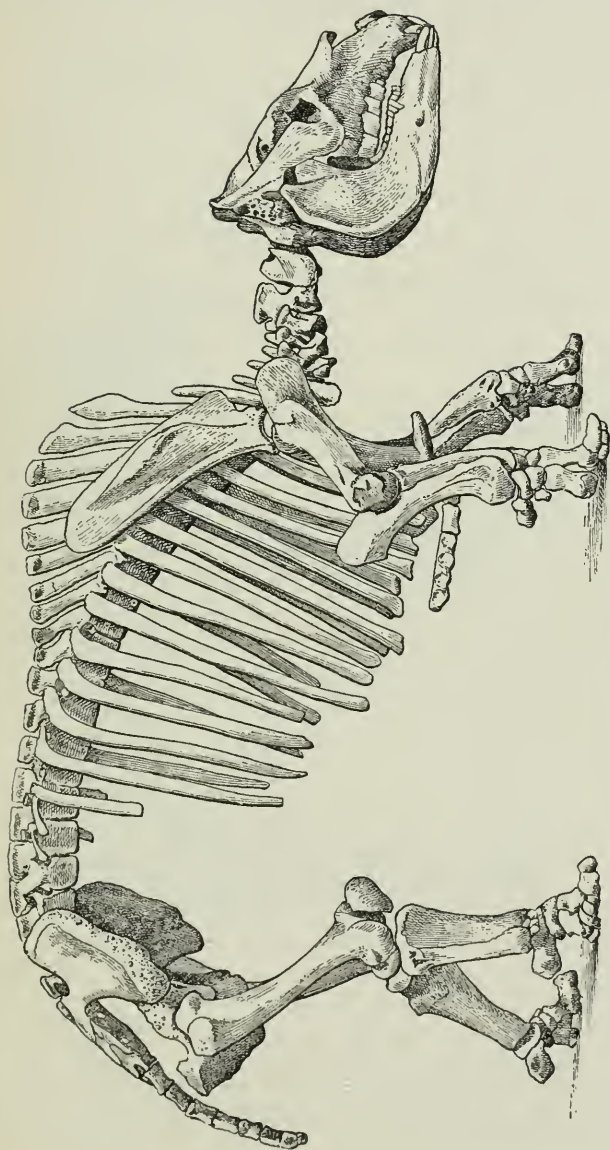


FIG. 41.—Skeleton of *Torodon platensis*, from the Pampa Formation of Buenos Aires, Argentine Republic; one-eighteenth nat. size. (Case T.)

Table-case 11. the case in all Ungulata with similar feet living in the northern hemisphere. Some of the small **Proterotheriidae**, which are found in the Santa Cruz Formation (perhaps Miocene) of Patagonia, have the toes reduced to one on each foot, exactly as in the horses; but here again the ulna and fibula are complete. They are named *Litopterna* ("smooth heel") because the calcaneum is provided with a smooth facette for articulation with the end of the fibula. In outward appearance they must have been much like pigmy horses.

SUB-ORDER 11.—**Proboscidea.**

Wall-cases 28, 43. The elephants at the present day are found only in Africa and the Indian region, but during the Pleistocene period they ranged over nearly the whole of the northern hemisphere, **Pier-cases 29-42.** roaming even within the Arctic circle. The mammoth **Table-cases 17-24.** (*Elephas primigenius*), which was almost identical with the living Indian elephant, had the widest distribution, its remains being especially abundant in the frozen Arctic lands and occurring almost everywhere in the north temperate region. There were local variations of the species; and among other features it may be noticed that the grinding teeth from the north exhibit finer and closer triturating plates than do those from the south, both in the Old World and in America, where the extreme southern forms are known as *E. armeniacus* and *E. columbi* or *texanus* respectively. No mammoths, however, were larger than the modern Indian elephant, and they can only be said to have commonly exceeded this living species in the development of their stout curly tusks, of which several fine examples (one from Eschscholtz Bay measuring 12 ft. 6 in. along the curve) are shown in **Pier-case 29 (30)** and on the top of this and adjacent **Pier-cases.** These tusks are so common and so well preserved in some parts of the Arctic regions, that they are a valuable source of ivory and have long been collected as an article of commerce. The mammoth is, indeed, best known from discoveries within the Arctic circle, where not only the fresh bones and teeth but also whole carcasses are occasionally met with in the frozen earth. One such carcass was made known to science a century ago by Adams, who found it at the mouth of the Lena and brought the greater part of the skeleton, with the head and feet still covered by the skin and soft parts, to St. Petersburg in 1806. Photographs of this skeleton, as it is now mounted with some

Pier-case 29 (30).

restoration in the Imperial Academy of Sciences at St. Petersburg, are placed on the wall adjoining Pier-case 30 (see also Fig. 42). Another carcase of a small, young male, exposed by a landslip on the banks of the Beresowka, an affluent of

Pier-cases
29, 31.

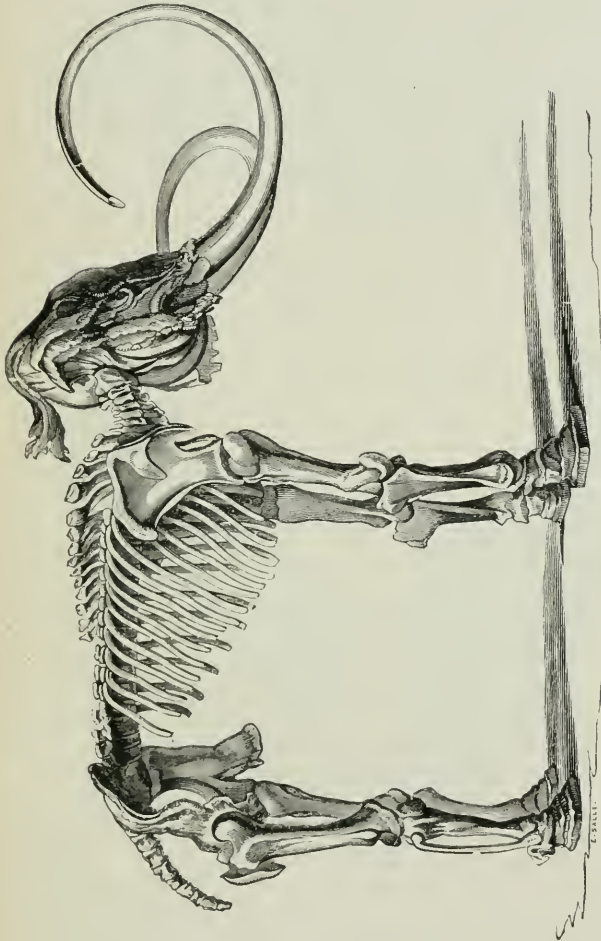


FIG. 42.—Skeleton of Mammoth (*Elephas primigenius*), with remains of dried skin on head and feet, discovered in frozen earth near the mouth of the river Lena, Siberia, and now in the Zoological Museum of the Imperial Academy of Sciences, St. Petersburg.

the Kolyma, in the government of Jakutsk, was scientifically excavated by an expedition from the St. Petersburg Academy in 1902; and photographs of the specimen, taken by Dr. Herz during the progress of its disinterment, are placed with

- Pier-cases 29, 31.** explanatory sketches on the pillar between Pier-cases 31 and 32. This animal evidently fell into a hole when quietly browsing on grass; its sprawling attitude shows that it attempted to scramble out; a great amount of clotted blood found in the chest-cavity indicates that it burst a blood-vessel by over-exertion; and a mouthful of grass between the teeth, not yet swallowed, proves that death was quite sudden. This specimen has been skilfully preserved in the Imperial Academy of Sciences at St. Petersburg, the skin being partially restored and stuffed in the attitude of the death-struggle, and the skeleton mounted separately. As proved by this and other discoveries, the Arctic mammoth was well clothed in reddish-brown wool and long black hair, while the tail was tipped by a large tassel of hair. A piece of the woolly skin and a bottle filled with the long hair are exhibited with the collection of remarkably fresh bones of the mammoth from the Arctic regions in Pier-case 31. Photographs and fragments of another carcase of a mammoth found with a rhinoceros, preserved by petroleum in a Pleistocene deposit in Galicia, Austria, are fixed on the wall near Pier-case 32. Jaws, teeth and bones from the Thames valley, including the Brady Collection from Ilford, are arranged in Pier-case 32 and Table-case 17; while the finest skull of a mammoth (with complete tusks 10 ft. 6 in. in length) hitherto discovered in Britain, is mounted in Case M. This specimen was also found in a brickfield at Ilford, and seems to have been associated with a whole skeleton, which was unfortunately dug out in pieces and sold by the workmen to a local rag and bone merchant before the interest of the discovery was recognised. In the English collection there is evidence of mammoths of all ages, and an instructive series of teeth of young individuals is placed in Table-case 17A. The specimens of greatest geological antiquity are the molars in Table-case 17 obtained by Mr. A. C. Savin from the Norfolk Forest Bed. Molars from numerous localities in England and on the Continent, in Table-case 18, illustrate distribution and variation; and a series dredged from the bed of the North Sea (chiefly the Owles Collection) is placed in Table-case 19 (Figs. 43, 44). Molars of the southern race from the Old and New Worlds, named *Elephas armeniacus* and *E. columbi*, are shown in Table-case 17.
- Pier-case 31.**
- Pier-case 32.**
- Case M.**
- Table-cases 17, 17a.**
- Table-cases 18, 19.**

The Pleistocene allies of the existing African elephant had a less extensive geographical distribution than the mammoth, and they never ranged sufficiently far north to

pass into the New World. The best known species is *Elephas antiquus*, with narrow molar teeth (Fig. 45) and straight tusks, which has not been found farther north than

Table-cases
18, 19.

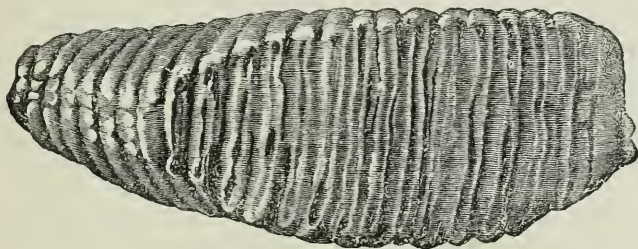


FIG. 43.—Grinding surface of left last upper molar tooth of Mammoth (*Elephas primigenius*), dredged off the Dogger Bank, North Sea, one-quarter nat. size. (Table-case 19.)

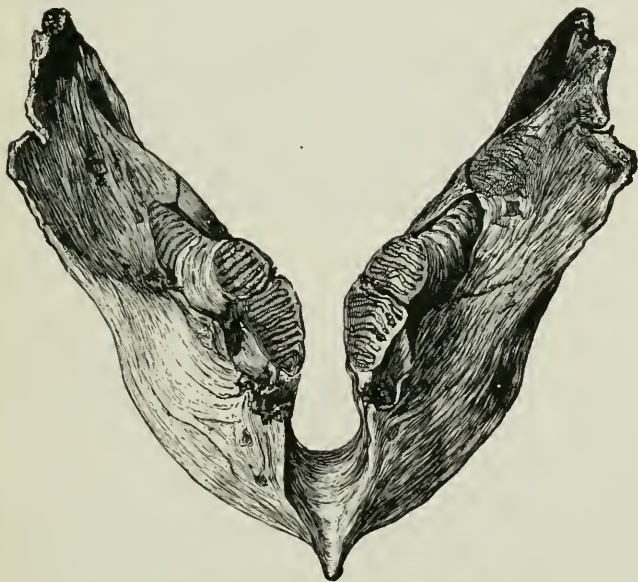


FIG. 44.—Mandible of Mammoth (*Elephas primigenius*), dredged off the Dogger Bank, North Sea; one-sixth nat. size. (Pier-case 32.)

the Kirkdale Cave in the Vale of Pickering, Yorkshire. The teeth are less common in Europe than those of the mammoth, but a good English collection is exhibited in Pier-case 33, and the series includes a characteristic straight tusk. The

Pier-case
33.

Pier-case 33. most ancient specimens were obtained from the Norfolk Forest Bed and from the Pliocene Norwich Crag. Molars of young individuals, chiefly found in England, are arranged in Table-case 19A. Teeth intermediate between those of *E. antiquus* and *E. africanus* occur in northern Africa, and there are remains of dwarf races in the caverns of Malta, Sicily, and Cyprus. The pigmy elephants of Malta (*E. melitensis* and *E. mnaidriensis*) and Cyprus (*E. cypriotes*) are especially interesting, and must have varied from three to seven feet in height when full-grown. A large collection of their remains is exhibited in Table-cases 17A, 21, 21A, those from Malta having been collected by Admiral Spratt and Professor Leith Adams, those from Cyprus by Miss D. M. A. Bate. There are also a few jaws and teeth of the Sicilian forms in Table-case 21. It is commonly supposed that these animals were stranded on the islands where the remains are found,

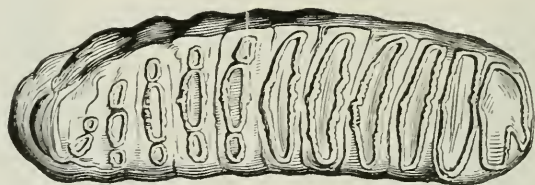


FIG. 45.—Grinding surface of right second lower molar tooth of *Elephas antiquus*, from the Pleistocene of Grays, Essex; one-third nat. size. (Pier-case 33.)

when the Mediterranean assumed its present extent in the Pleistocene period and disintegrated the once continuous mainland. Their small size and innumerable variations are thus ascribed to the struggle for existence on a reduced and unfavourable feeding ground.

Table-case 20. The largest known elephant, apparently allied to the surviving African species, lived during the Upper Pliocene period to the dawn of the Pleistocene in the southern half of Europe. It was first discovered in the valley of the Arno, Italy, and named *Elephas meridionalis*. A nearly complete skeleton from Durfort, Gard, France, now mounted in the Paris Museum, shows that the animal must sometimes have measured 14 or 15 feet in height. Molar teeth (Fig. 46) and other remains occur in the Norfolk Forest Bed, and a good collection is exhibited with some Italian specimens in Table-case 20. A few pieces are also shown from the Pliocene Red

Crag and Norwich Crag, and there is one molar from a fissure in the Chalk at Dewlish, Dorset. Photographs of the circumstances under which the latter specimen was discovered are fixed on the wall in the bay between Pier-cases 34, 35.

Remains of true elephants are quite common in the Lower Pliocene Siwalik Formation and in the Pleistocene river-deposits of India. All of these are closely related to the living Indian elephant, but some, such as *E. planifrons* and *E. hysudricus*, seem to be intermediate between the surviving Indian and African species. The Cantley Collection and numerous other specimens in Pier-cases 33 and 34, Table-case 22, and on special stands, form a unique illustration of these extinct members of the Indian fauna.

Table-case
20.

Pier-cases
33, 34.
Table-case
22.
Stands O,
P, W.

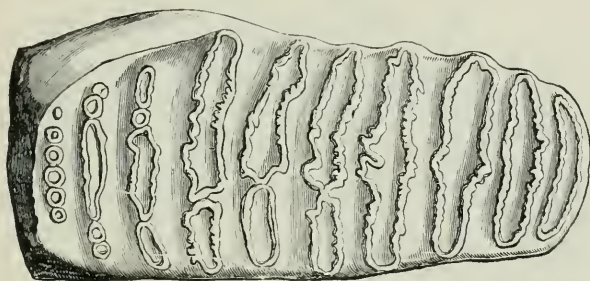


FIG. 46.—Grinding surface of upper molar tooth of *Elephas meridionalis*, from the Upper Pliocene of Tuscany; one-third nat. size. (Table-case 20.)

The Indian species just mentioned are the earliest known examples of the true elephant, which thus makes its first appearance in the Lower Pliocene of Asia. With the typical kinds are associated other elephants which possess more primitive grinding teeth, and show how the elephantine molar originated. They prove, in fact, that this ponderous tooth has gradually arisen in the elephant tribe by the enlargement and complication of a tooth with a few cross-ridges. The first stage (among elephants with a normal proboscis or trunk) is found in *Mastodon* ("nipple-tooth"), which is represented by *M. siradensis* (Fig. 50) and other species in the Siwalik Formation (see Pier-case 37 and Table-case 23). A longitudinal vertical section of this kind of tooth (Fig. 47) displays the thick cross-ridges separated by wide valleys, which are quite empty or only partially blocked by small supplementary knobs or ridges. The next stage, named *Stegodon* ("roof-tooth") in allusion to the

Pier-case
37.
Table-case
23.

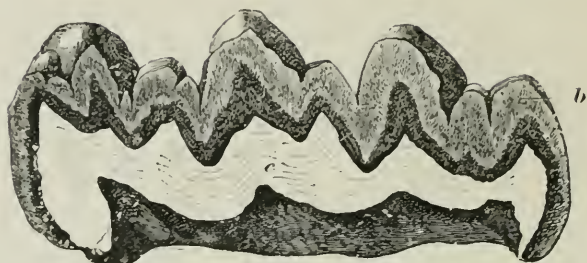


FIG. 47.—Vertical longitudinal section of molar tooth of *Mastodon*, showing open valleys between cross-ridges, thick enamel (*b*), and the dentine (*c*); two-thirds nat. size. (Table-case 24.)



FIG. 48.—Vertical longitudinal section of molar tooth of *Elephas (Stegodon) insignis*, from the Lower Pliocene of the Siwalik Hills, India, showing wide valleys between cross-ridges filled with cement (*a*), the layer of enamel (*b*), and the dentine (*c*); one-third nat. size. (Table-case 24.)



FIG. 49.—Vertical longitudinal section of molar tooth of *Elephas planifrons*, from the Lower Pliocene of the Siwalik Hills, India, showing deep valleys between cross-ridges filled with cement (*a*), the layer of enamel (*b*), and the dentine (*c*); one-third nat. size. (Table-case 24.)



FIG. 50.—Grinding surface of lower molar tooth of *Mastodon sivalensis*, from the Lower Pliocene of the Siwalik Hills, India ; two-thirds nat. size. (Table-case 23.)

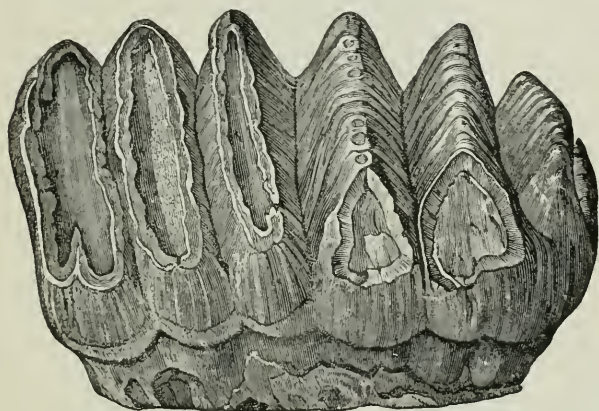


FIG. 51.—Grinding surface of upper molar tooth of *Elephas (Stegodon) clifti*, from the Lower Pliocene of the Siwalik Hills, India ; one-half nat. size. (Pier-case 36.)

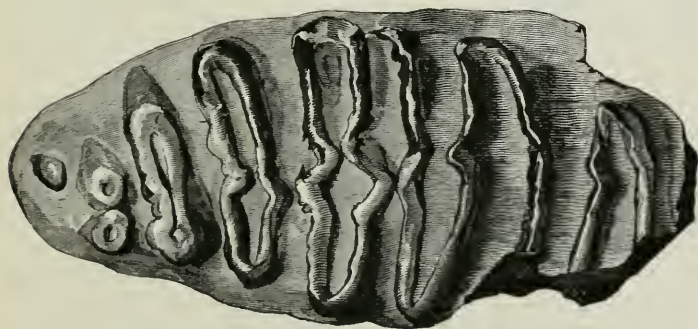


FIG. 52.—Grinding surface of incomplete upper molar tooth of *Elephas planifrons*, from the Lower Pliocene of the Siwalik Hills, India ; two-thirds nat. size. (Pier-case 34.)

Pier-cases 35, 36. angular roof-like shape of the cross-ridges of the teeth (Figs. 48, 51), has these ridges more numerous and usually deeper, while the intervening valleys are partly filled with a soft tooth-substance termed cement. *Stegodon* is generally regarded as a sub-genus or section of *Elephas* proper, and various remains of it from India, Burma, and China are exhibited in Pier-cases 35, 36. A fine skull of *Elephas* (*Stegodon*) *ganesa* with immense tusks (Fig. 59) from the Siwalik Formation, presented by General Sir W. E. Baker, is mounted on a separate stand (K). In the true *Elephas* the tooth-ridges are excessively deepened and comparatively numerous (Figs. 49, 52), while the intervening valleys, now mere crevices, are filled to overflowing with cement. This progressive complication is well illustrated by a series of sections of teeth arranged in regular order in Table-case 24.

Pier-cases 35, 36. Stand K. The Pliocene *Stegodon* has only been found in southern and central Asia, some of the adjacent islands, and northern Africa. *Mastodon*, however, ranged over southern and central Europe, and in the Pleistocene period extended nearly throughout North and South America. Among European species may be mentioned *M. arvernensis*, from the Upper Pliocene of France, Italy, Germany, and the Red Crag of England, illustrated in Pier-case 37 and Table-case 23; also *M. atticus* and *M. pentelici* from the Lower Pliocene of Greece, exhibited in the same Cases. Among North American species *M. americanus* (Figs. 53, 54) is the most important, and is represented not only by the partially reconstructed skeleton (Stand B) at the entrance to the Gallery, but also by numerous remains in Pier-cases 38, 39, and Table-case 23. It lived until the arrival of prehistoric man in North America, as shown by the occurrence of stone arrow-heads with its bones. The best known South American species is *M. humboldti*, of which a fine skull is mounted in Pier-case 39 (40). Though found nearly all over South America, its remains are especially abundant in the lake deposits or flood deposits in the valley of Tarija, Bolivia, where large herds must have perished.

Pier-case 37. Table-case 23. Pier-cases 38, 39. Table-cases 23, 24. Stand B.

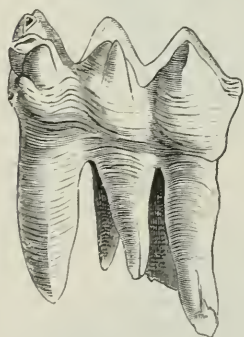


FIG. 53.—Lower molar tooth of *Mastodon americanus*, from the Pleistocene of North America; one-third nat. size. (Table-case 23.)

South America, its remains are especially abundant in the lake deposits or flood deposits in the valley of Tarija, Bolivia, where large herds must have perished.

The Pliocene and Pleistocene mastodons just enumerated clearly possessed the ordinary elephant proboscis, and would be elephants to all outward appearance. Young individuals, however, exhibit a diminutive pair of tusks projecting from the front of the lower jaw. They are thus reminiscent of their Miocene predecessors in Europe and Africa, which had well-developed lower tusks throughout life. These ancestral mastodons, of the genus *Tetrabelodon*, are illustrated by numerous remains from the Middle and Upper Miocene and Lower Pliocene of Europe, and by one mandible from Kansas,

Pier-cases
38-42.
Table-cases
23, 24.
Stand B.

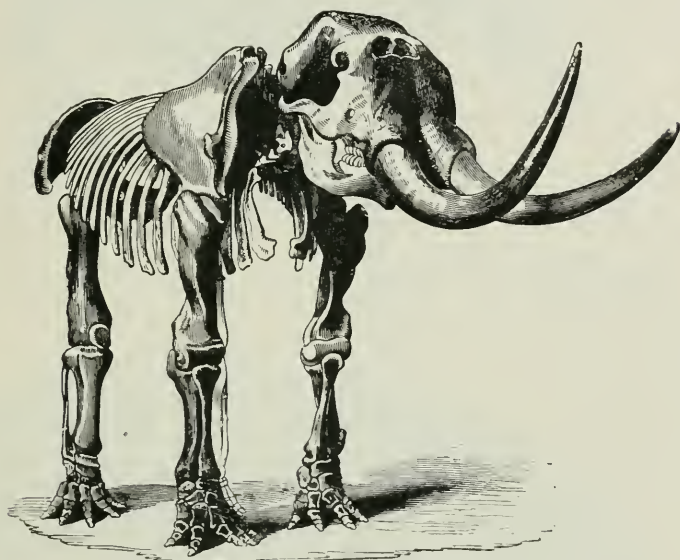


FIG. 54.—Skeleton of *Mastodon americanus*, from the Pleistocene of Benton County, Missouri, U.S.A.; height 9 ft. 6 in., length 20 ft., and length of tusks 5 ft. 6 in. (Stand B.)

U.S.A., in Pier-case 41 (42). None of the species were so large as those of the genus *Mastodon* itself. Their skull (Fig. 60) is like that of an elephant, and the spreading upper tusks only differ from modern elephant tusks in having a band of enamel along one side. Their lower jaw, however, is produced at the chin (symphysis) into a remarkable bony spout-shaped elongation, tipped with a pair of chisel-shaped tusks, which cannot have worked against the upper tusks, but evidently met some kind of pad on the palate. *Tetrabelodon* must thus have possessed an immensely elongated

Pier-case
41.

Pier-case
41.

face, and as its neck was longer than that of a modern elephant, it would be able to reach the ground with the front of its mouth. The general shape of the animal is well shown by a partially restored skeleton in the Paris Museum, of which a photograph is placed on the wall near Pier-case 41 (see also Fig. 55).

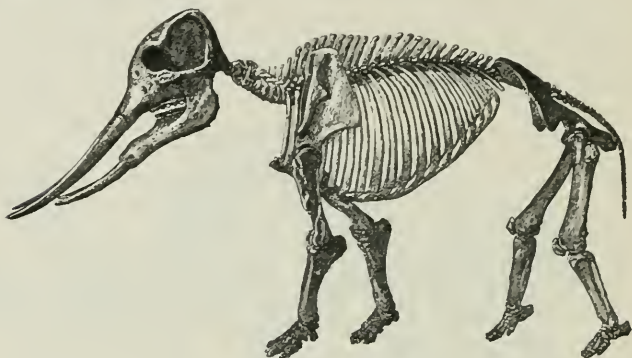


FIG. 55.—Skeleton of *Tetrabelodon angustidens*, from the Middle Miocene of Sansan, France; greatly reduced. (After A. Gaudry.)

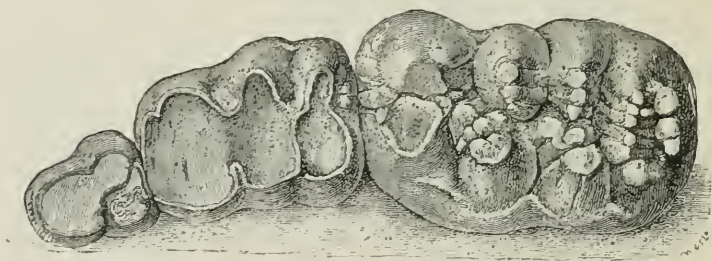


FIG. 56.—Left upper milk-molars of *Tetrabelodon longirostris*, from the Lower Pliocene of Eppelsheim, Hesse-Darmstadt; nat. size. (After A. Gaudry.)

Wall-case
43.
Case C.

Dinotherium, a contemporary of *Tetrabelodon*, with smaller, simpler and more numerous grinding teeth, has the bony symphysis of its mandible bent downwards and the terminal lower tusks curved backwards. The only known skull of this animal, with a plaster cast of the mandible (Fig. 57) from the Lower Pliocene of Eppelsheim, Hesse-Darmstadt, is mounted in a special Case marked C; and teeth (Fig. 58)

and other remains both from Europe and the Siwalik Formation of India, are exhibited.

Wall-case
43.
Table-case
23.
Case C.

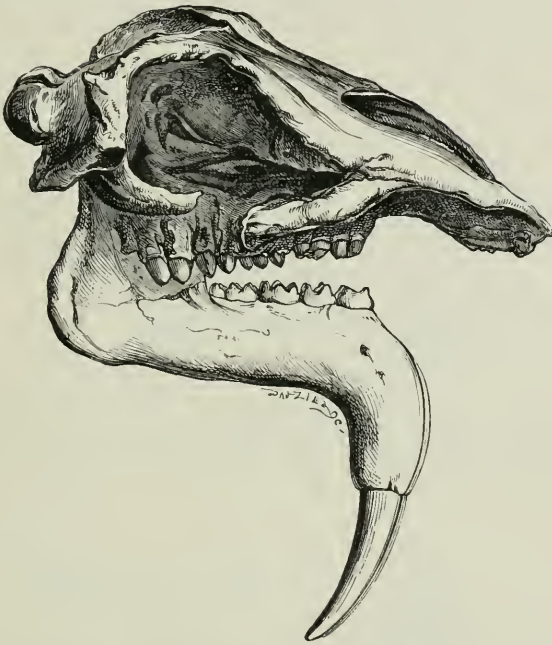


FIG. 57.—Skull and mandible of *Dinotherium giganteum*, from the Lower Pliocene of Eppelsheim, Hesse-Darmstadt; one-fifteenth nat. size. (Case C.)

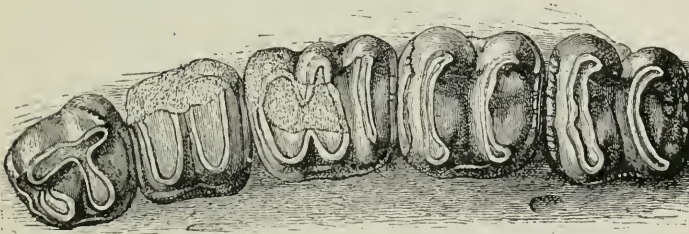


FIG. 58.—Left upper teeth of *Dinotherium levius*, from the Middle Miocene of Sansan, France; one-quarter nat. size. (After A. Gaudry.)

No Proboscidean earlier than *Tetrabelodon* occurs in Europe; but it is preceded in the Upper Eocene of Egypt by a still smaller animal, *Palæomastodon*, of which a fine skull

Wall-case
43.

Wall-case 43. and mandible and other remains are exhibited in Wall-case 43. This genus (Fig. 61) resembles *Tetrabelodon* in its tusks

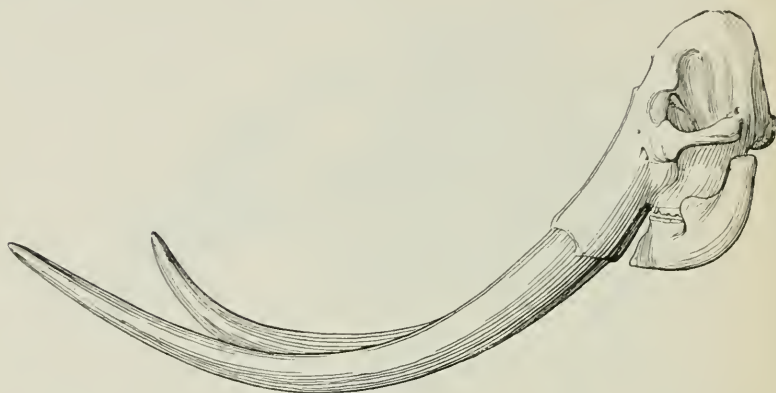


FIG. 59.—Skull and lower jaw of *Elephas (Stegodon) ganesa*, showing immense tusks, from the Lower Pliocene of the Siwalik Hills, India; one thirty-second nat. size. (Stand K.)

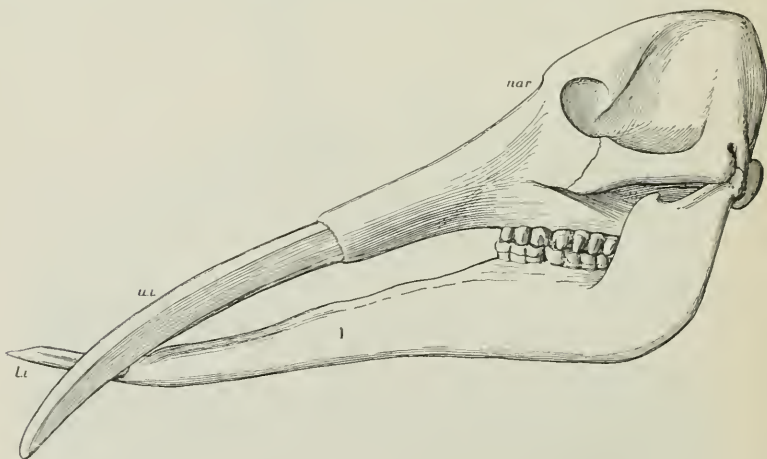


FIG. 60.—Skull and lower jaw of *Tetrabelodon angustidens*, showing elongated chin with pair of terminal cutting teeth (*li.*), from the Middle Miocene of Sansan, France; one-twentieth nat. size. *nar.* position of nostrils; *u.i.* upper incisor or tusk. (After C. W. Andrews.)

and elongated face, but differs in having a less elephant-like skull, with more numerous and relatively smaller grinding teeth. It is preceded again in the Middle Eocene of Egypt

by *Mocritherium* (Fig. 62), which comprises still smaller species whose relation to *Elephas* would hardly be suspected if all the intermediate gradations were unknown. Here the cross-ridged molars are first becoming recognisable ; one pair

Wall-case
43.

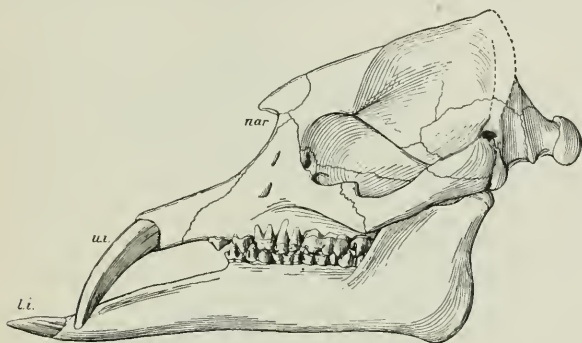


FIG. 61.—Skull and lower jaw of *Palaeomastodon beadrnelli*, showing elongated chin with pair of terminal cutting teeth (*Li.*), from the Upper Eocene of the Fayum, Egypt; one-twelfth nat. size. *nar.* position of nostrils; *u.i.* upper incisor or tusk. (After C. W. Andrews.)

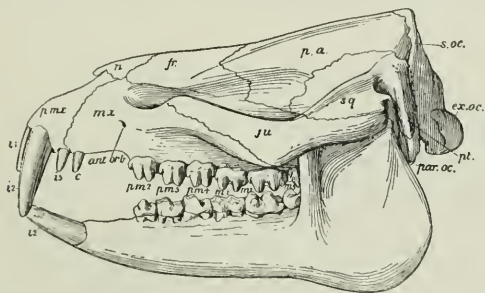


FIG. 62.—Skull and lower jaw of *Mocritherium lyonsi*, from the Middle Eocene of the Fayum, Egypt; one-seventh nat. size. *ant. orb.*, antorbital foramen; *c.*, canine; *ex. oc.*, exoccipital; *fr.*, frontal; *i. 1-3*, incisors; *ju.*, jugal; *m. 1-3*, molars; *m.x.*, maxilla; *n.*, nasal; *p.a.*, parietal; *par. oc.*, paroccipital; *p.m. 2-4*, premolars; *p. m.x.*, premaxilla; *pt.*, post-tympanic process of squamosal; *s. oc.*, supraoccipital; *sq.*, squamosal. (After C. W. Andrews.)

of incisors above and below is growing at the expense of its fellows to become real tusks ; and the arrangement of the bones of the skull is beginning to show features which are known only in the order Proboscidea. Several instructive fragments and plaster casts of skulls from the Cairo Museum are placed in Pier-case 43.

Wall-case
43.

A series of models of the skulls of *Mocritherium*, *Palæomastodon*, and *Tetrabelodon* is arranged for comparative study on the front part of Stand B.

The fossils, so far as known, show therefore that the earliest forerunners of the elephants were small marsh-dwellers which lived on a succulent food in the African region. They gradually increased in size, without essentially altering their limbs and body; but as their legs lengthened and their neck shortened, their face and chin gradually became elongated to reach the ground for browsing. When this strange adaptation had reached its maximum degree, the chin suddenly shrivelled, leaving the flexible, toothless face without any support. Thus arose the unique proboscis of the elephants, which has become prehensile by stages which cannot be traced, because soft parts are not preserved in ordinary geological formations.

Stands E, F,
G, H, I, J.

For comparison, a stuffed modern Indian elephant, a skeleton of the same, and a newly-born individual of the same, are placed in the middle of the Gallery; while skulls and tusks are arranged in the bay between Pier-cases 36 and 37, and in Wall-case 28.

ORDER VI.—RODENTIA.

Table-case
16.

Fossil remains of rodents or gnawing mammals are common in Tertiary formations throughout the world, and a typical collection is exhibited in Table-case 16. The extinct kinds, however, do not differ much from those now living, although they can be traced back as far as the Middle Eocene period.

Among the fossil remains of Sciuromorpha, those of the beaver (*Castor*) are conspicuous. This animal first appears in the Upper Pliocene of Italy, France, and England; and the common *C. fiber* had a remarkably wide range in Europe during the Pleistocene period. Good specimens are shown from the Fen-land (Fig. 63) and from the valley of the Lea, Essex. It does not appear to have been exterminated in Britain until about the twelfth century, and there are still allusions to it in some names of places (e.g., Beverley and Nant-yr-afanewn). *Trogotherium cuvieri* is a giant beaver, which ranged from Russia to England during early Pleistocene times. A skull, jaws, and other remains from the Norfolk Forest Bed are exhibited, with plaster casts of a Russian skull and mandible of the same species.

Among Myomorpha, it is interesting to notice that the lemmings (*Myodes lemmus* and *Cuniculus torquatus*) occur in the Pleistocene of England. There are also remains of a large dormouse (*Leithia melitensis*) found with the pigmy elephants in the caverns of Malta.

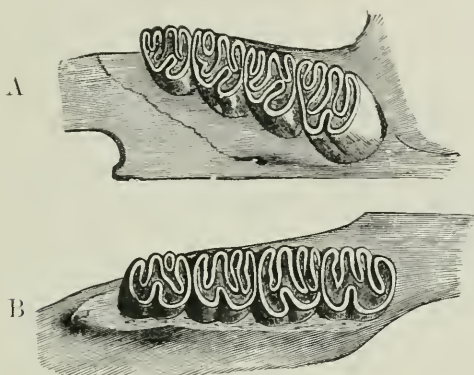


FIG. 63.—Left upper (A) and right lower (B) teeth of Beaver (*Castor fiber*), from the Fens of Cambridgeshire; nat. size.

Among Hystricomorpha, a skull of the gigantic *Castoroides ohioiticus* from the Pleistocene of North America is shown; and there is a drawing of a complete skeleton of this animal, natural size, on the adjacent wall. There are also remains of various genera from South America, where the extinct Pleistocene *Megamys* must sometimes have been as large as an ox.

The Lagomorpha, or rabbits, picas, and hares, date back to the Oligocene period.

ORDER VII.—SIRENIA.

The extinct representatives of the “sea-cows,” so far as known, are very little different from the surviving members of the Order. Discoveries in Egypt merely suggest that during the Eocene period they were most closely connected with the early Proboscidean Ungulata. Various fossils show that in Tertiary times they had a wider geographical distribution than at the present day.

Steller’s Sea-cow (*Rhytina gigas*), which formerly browsed on the sea-weed on the shores of Bering Strait, lived until 1782, when it was exterminated by the Russian sailors who

Pier-case
29 (30).
Case V.

Pier-case
29 (30).
Case V.

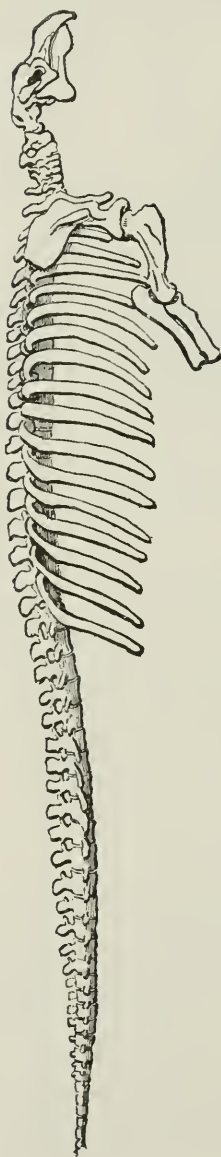


FIG. 64.—Skeleton of Steller's Sea-cow (*Rhytina gigas*), from Pleistocene of Bering Island; one-fortieth nat. size. (Case V.)

fed upon its flesh. It was described by Steller, a German naturalist in the Russian service in 1751, and a copy of his drawing of the living animal is fixed on the Pillar between Pier-cases 20 and 21. This massive creature sometimes attained a length of 25 feet; and a nearly complete skeleton of an individual about 20 feet long (Fig. 64) is mounted, with other remains, in a large case marked V. *Rhytina* was destitute of teeth, which were replaced by corrugated, horny plates; it also appears to have lacked ordinary hands. Its bones occur in the peat-bogs and swamps of the islands round which it lived, and they are discovered by prodding the soft ground with an iron bar which strikes them.

Halitherium, from the Oligocene and Lower Miocene of Europe, is essentially a manatee, but it lacks the apparently unlimited supply of grinding teeth which characterise the surviving animal. It also exhibits a less rudimentary pelvis than any other known Sirenian, with a small bone representing the femur. A well-preserved small skeleton and a restored model of a larger skeleton of *Halitherium schinzi* (Fig. 65), from the Oligocene of Hesse-Darmstadt, are mounted in Case V. There is also an imperfect skull, named *Halitherium canhami*, from the Red Crag of Suffolk (see Table-case 1A). *Felsinootherium* is a closely similar animal from Northern Italy.

Prorastomus is another extinct genus known only with certainty by the unique skull from an early Tertiary limestone in Jamaica, which is exhibited in Pier-case 29

Pier-case
29 (30).

(30). It is peculiar in possessing a complete set of teeth, incisors and canines as well as premolars and molars. Fragments of jaws, possibly of another species of the same genus, occur in the Upper Eocene of Northern Italy.

Pier-case
29 (30).

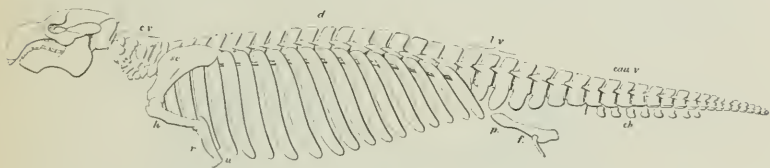


FIG. 65.—Skeleton of *Halitherium schinzi*, from the Oligocene of Hesse-Darmstadt; one twenty-fifth nat. size. (Case V.)

The oldest known Sirenians are *Eotherium* and *Eosiren* from the Middle Eocene of Egypt. Brain-casts, a plaster cast of a skull, and other remains are exhibited in Pier-case 29 (30).

Skeletons and stuffed specimens of the living manatees and dugongs are placed in Case V and Pier-case 29 (30) for comparison with the fossils. See "Guide to the Galleries of Mammals," p. 84.

ORDER VIII.—CETACEA.

The fossil remains of whales, porpoises, and dolphins are placed with the living members of the Order in the Gallery of Cetacea (Department of Zoology). They are all very fragmentary.

Gallery of
Cetacea,
Zool. Dept.

The typical modern Balænidæ do not occur below the Pliocene, where they are represented chiefly by ear-bones (tympanics), of which a good series from the Red Crag of Suffolk is exhibited (Fig. 66). Small whalebone whales, however, existed so long ago as the Oligocene period both in Europe and North America, although there are no remains in the collection.

Teeth and bones of the toothed whales are more frequently met with among fossils. All the kinds which still live seem to have been in existence before the close of the Pliocene period. Even the strange compact snouts of the beaked whales, such as *Mesoplodon*, are common fossils in the Pliocene Crag of England and Belgium, and a good collection is mounted for exhibition. Some of the earlier

Gallery of
Cetacea,
Zool. Dept.

toothed whales of the Miocene period differed from every Cetacean now living, and approached more normal mammals in the circumstance, that all their teeth were enamelled, while some of those at the back of the jaw were two-rooted. Instructive illustrations may be seen in plaster casts of skulls of *Squalodon grateloupi* from the Miocene of France and



FIG. 66.—Tympanic bone of Whalebone whale (*Balæna primigenia*), from the Red Crag of Suffolk; one-half nat. size.

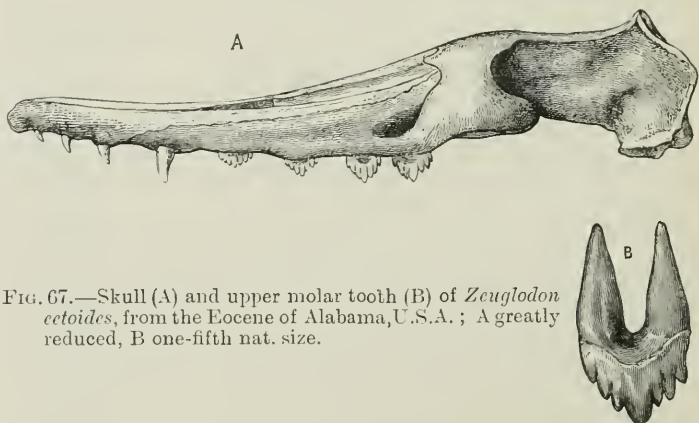


FIG. 67.—Skull (A) and upper molar tooth (B) of *Zeuglodon cetoides*, from the Eocene of Alabama, U.S.A.; A greatly reduced, B one-fifth nat. size.

Bavaria, and in an almost unique skull of *Prosqualodon australis* from the Patagonian Formation of South America.

The Miocene toothed-whales with enamelled two-rooted teeth are especially interesting, because they connect the modern simple-toothed tribes with some whale-like creatures, the Zeuglodonts, which appear to have flourished in all seas

during the Eocene period. *Zeuglodon* (yoke-tooth), thus named by Owen in allusion to the shape of its hinder teeth (Fig. 67B), has jaws so peculiar that they were originally supposed to belong to a reptile, which was termed *Basilosaurus*. The skull (Fig. 67A) is not completely that of a whale, though it is elongated and depressed, with the nostril on the middle of the upper surface. Each side of either jaw is provided with four simple teeth in front and five double-rooted teeth behind. The neck must have been unusually long for a whale and not rigid. Plaster casts of the skull and teeth, besides actual teeth of the typical *Zeuglodon cetoides*, from the Eocene of Alabama, U.S.A., are exhibited, proving the animal to have been of rather large size. *Prozeuglodon*, represented by a plaster cast of a skull from the Middle Eocene of the Fayum, Egypt, has some three-rooted teeth, and seems to connect toothed whales with Creodonta (see p. 16).

Gallery of
Cetacea,
Zool. Dept.

ORDER IX.—**EDENTATA.**

The sloths, anteaters, and armadillos have been characteristic of the South American region since early Tertiary times, and they do not appear to have wandered farther than the southern part of North America at any period. They are quite a degenerate and insignificant race at the present day, compared with their former representatives.

The modern sloths and anteaters are almost unknown among fossils, but the peculiarities of both these families are combined in the skeleton of the extinct **ground-sloths**. These animals, in fact, exhibit the head and teeth of a sloth associated with the back-bone, limbs, and tail of an anteater. They lived in great numbers in South America during the latter part of the Tertiary period, ranging even so far north as Kentucky in the Pleistocene; and some of them survived to be contemporaries of man at a very recent Prehistoric date. The Miocene or perhaps earlier forms are small, but they become larger as they are traced upwards in the geological sequence, and many of the Pleistocene and Prehistoric species rival elephants and rhinoceroses in bulk.

The best known ground-sloths are *Megatherium*, *Scelidotherium*, and *Myodon*, all well represented in the collection. They obviously could not live in trees like the little sloths which exist at present in the South American forests; but their hind quarters are very massive and their stout tail would serve with their hind legs to form a rigid tripod on

Wall-case
26.
Table-cases
14b, 15a.
Case Y.

Stand X.
Case Y.

which they could rest when reaching the leaves of trees for food. A plaster cast of the skeleton of *Megatherium*, 18 feet

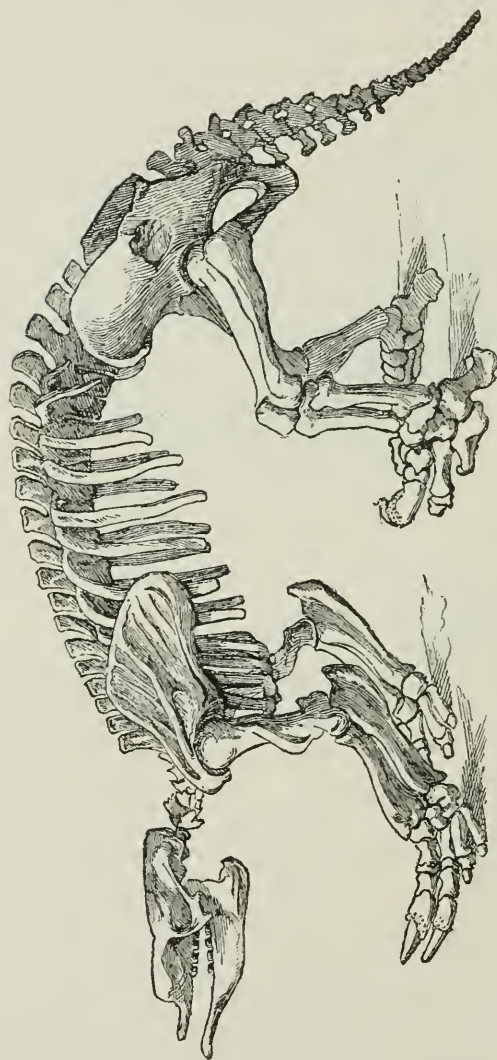


FIG. 68.—Skeleton of *Scelidotherium leptcephalum*, from the Pampa Formation of Buenos Aires, Argentine Republic; about one-sixteenth nat. size. (Wall-case 25.)

long, and a slightly restored actual skeleton of *Mylodon*, somewhat smaller, are mounted on stands marked X, Y, in the attitude which it is believed they usually assumed when

feeding. The original bones and teeth of *Megatherium*, other remains of *Mylodon*, and numerous parts of the skeleton of *Scelidotherium* (Fig. 68) are arranged in Wall-case 26. The bones bear conspicuous crests and ridges, which indicate the muscular power of these animals. The feet are twisted, so that their side rather than their palm would be used when walking; and one, two, or three of the toes on each foot terminate in a great claw. The fore quarters are arranged for the easy motion of the grasping arms. The front of the mandible is spout-shaped (see Figs. 68, 69), evidently adapted to a long protrusible tongue, which could be used like that of a giraffe for pulling leaves off the trees. The few grinding teeth would continually grow as they were worn down throughout life, and those of *Megatherium* (Fig. 69) are made

Stand X.
Case Y.

Stand X.

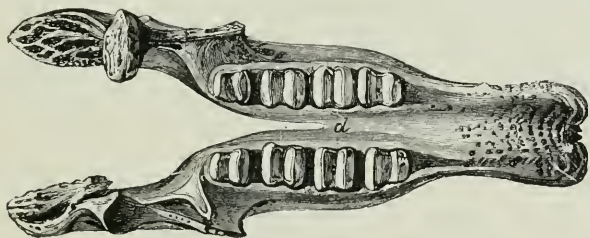


FIG. 69.—Lower jaw of *Megatherium americanum*, showing double-ridged molar teeth and long spout-shaped symphysis (*d*), from the Pampa Formation of Buenos Aires, Argentine Republic; one-eighth nat. size. (Wall-case 26.)

extremely powerful by consisting of alternate soft and hard plates of tooth-substance, which produce cross-ridges on the crown.

The skeletons of the ground-sloths are wonderfully well preserved in the Pampa Formation of the Argentine Republic, and it is the rule rather than the exception to find them whole. Most of them are discovered on the borders of old lakes and rivers, evidently in the position in which the animals suddenly died. They are supposed to have perished in the mud and soft ground when attempting to reach the water to drink during dry seasons; for droughts are common even at the present day in the country where they formerly lived. In the time of the ground-sloths, however, the pampa can scarcely have been the bare plain that it is now; it must have borne forest vegetation.

Both human bones and stone implements have occasionally

Table-case
15a.

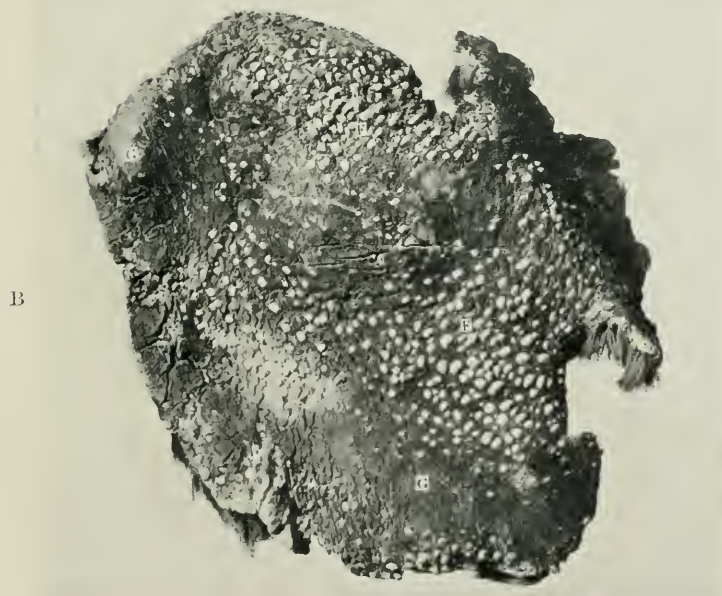
Table-case
15a.

been found in the province of Buenos Aires so intimately associated with remains of the ground-sloths that there can be no doubt as to the survival of these gigantic quadrupeds until the time of man at least in the southern part of South America. The most important discoveries, however, which appear to prove this survival, were made in 1897 and subsequent years by Dr. F. P. Moreno, Dr. R. Hauthal, Baron Erland Nordenskjöld, and others, in a cavern near Consuelo Cove, Last Hope Inlet, Patagonia, between the 51st and 52nd degrees of south latitude. Here, in an absolutely dry and powdery deposit on the floor of the large cavern, were found numerous broken bones of several individuals of a ground-sloth, *Grypotherium*, which was nearly as large as *Mylodon* and only differed from the latter in minor features. With the bones were several pieces of skin, evidently of the same animal, which showed marks of tools and seemed to have been stripped off the carcass by man. There were also large lumps of excrement, besides masses of cut grass which may have been intended for fodder. With the *Grypotherium* were found bones of other extinct animals; and in the same cavern there were implements of stone and bone, remains of fires, and even the bones of man himself. The Argentine explorers, in fact, concluded that the *Grypotherium* had actually been kept in the cavern and fed by man, who eventually killed the animals for food.

A series of specimens illustrating this discovery is exhibited in Table-case 15A. The sharply broken bones are remarkably fresh in appearance, still bearing the dried and shrivelled remains of gristle, sinews and flesh. The pieces of skin (Plate IV) are covered with dense, coarse hair on the outside; while the inner layer of their substance is filled with small nodules of bone, which are exposed on the inside where the skin is slightly decayed. Similar little bones have been found in great numbers with the skeletons of *Mylodon* in the Pampa Formation (see Wall-case 26), so that this ground-sloth and its allies must have been armoured with a bony mail beneath the hairy outer surface of the skin. The lumps of excrement from the cavern consist only of remains of grass, without any traces of leaves. Among associated animals may be particularly noted the extinct horse, *Onohippidium*, of which there are characteristic teeth besides many well-preserved hoofs.

Wall-case
26.

The **armadillos** which lived with the Pampean ground-sloths, were also gigantic compared with their existing



Skin of Extinct Ground-sloth (*Grypotherium listai*) from a Cavern near Last Hope Inlet, Patagonia; one-sixth nat. size. The outer side (A) bears coarse hair; the inner side (B) exhibits small nodules of bone imbedded in the substance of the skin. (Table-case 15A.)

[To face p. 74.]

representatives. They exhibit great variety, but their coat of mail (carapace) is always rigid, not divided into the over-

Wall-case
26.
Table-case
14b.
Case Z.

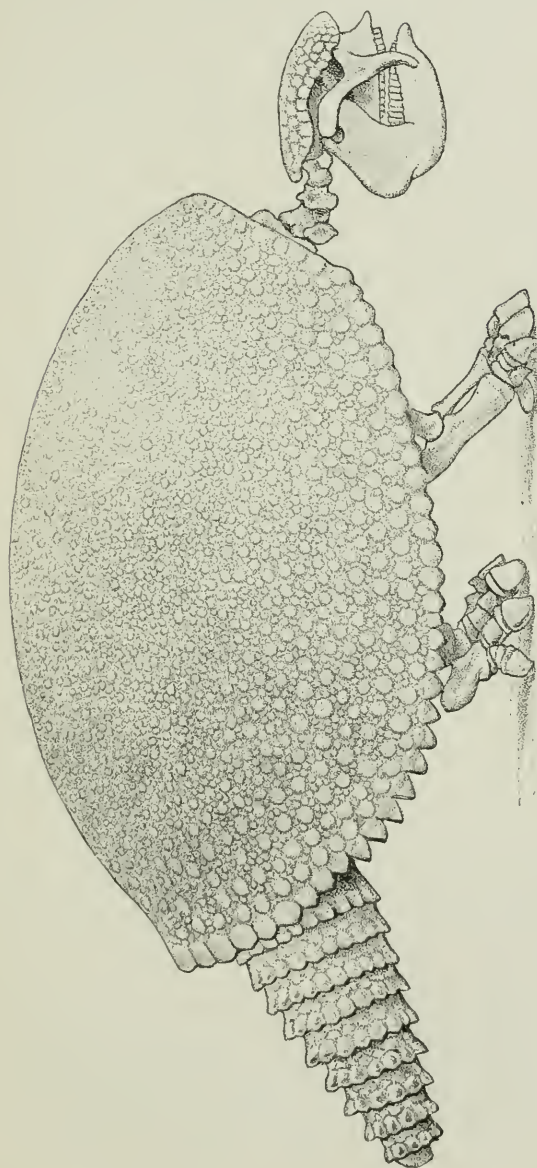


FIG. 70.—Skeleton of *Glyptodon clavipes*, from the Pampa Formation of Buenos Aires, Argentine Republic; one-eighteenth nat. size. (Case Z.)

Wall-case
26.
Table-case
14b.
Case Z.

lapping cross-bands which enable the surviving armadillos to roll into a ball when attacked. *Glyptodon* (Fig. 70) is one of the best known genera, and owes its name ("sculptured tooth") to the circumstance that hard and soft portions alternate in the teeth, thus imparting a sculptured appearance to their grinding surface. The actual armour of a fine specimen is mounted, with a plaster cast of the skeleton, in Case Z. As here exhibited the total length of the animal, measured along the curve of the back, is 11 feet 6 inches; while the body shield or carapace measures 7 feet in length by 9 feet across. The armour obviously consists of small bony rosettes or bosses compacted together, and it must have been originally covered with a thin outer skin. There is a little shield on the top of the head; and the covering of the tail is arranged in successive, overlapping rings. At times of danger, the animal would probably be able to draw up its

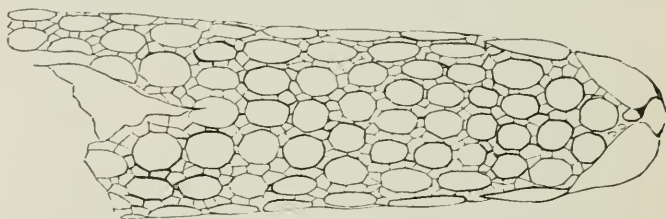


FIG. 71.—Portion of tail-sheath of *Hoplophorus*, from the Pampa Formation of the Argentine Republic; one-quarter nat. size. (Wall-case 26.)

legs close to the body, so as to rest its carapace on the ground, while its armour-plated head would be bent downwards in front. The massive tail must have moved freely behind the carapace, and in one genus, *Daclicurus*, the solid end of the tail-sheath is somewhat expanded to bear a cluster of bony bosses which would give it the aspect of a powerful club (see Wall-case 26). *Hoplophorus* is a smaller elongated animal having the end of the tail-sheath without rings (Fig. 71). It is illustrated by a good series of specimens in Wall-case 26.

Table-case
14b.

The earlier remains of armadillos from Patagonia, as shown by the collection in Table-case 14b, represent animals much smaller than those from the Pampa Formation, and some of them have a banded carapace like that of the living armadillos. It must, in fact, be understood that the tree-sloths of the present South American forests and the

burrowing armadillos of the existing pampa are not the degenerate descendants of the gigantic Pleistocene animals just described. If all their ancestors were known, they would probably prove to have been always small; and they have survived changes which the larger beasts could not withstand, because they exist in comparatively secure retreats and do not need a great amount of food.

It is sometimes doubted whether the so-called Edentata of the Old World—the **pangolins** and **aard varks**—are really related to the South American animals of this Order. Unfortunately, the known fossils do not help to solve the problem. Some small bones from the Oligocene Phosphorites of France, now in the Paris Museum, seem to belong to ancient pangolins; while skulls, jaws and teeth of the aard vark or Cape anteater (*Orycteropus*), which is now confined to Africa, are exhibited from the Lower Pliocene of Samos, Greece, and Persia (Table-case 14B). No animals ancestral to these are recognisable.

SUB-CLASS II.—METATHERIA.

ORDER X.—MARSUPIALIA.

Like the sloths and armadillos of South America, the kangaroos and wombats of Australia were preceded in the Pleistocene period by comparatively gigantic relatives. The largest of these rivalled the rhinoceros in bulk, and its thigh-bone was so completely adapted for the support of a massive body, that when it was first discovered it was mistaken by Owen for the thigh-bone of an elephant. The jaws, however, and other parts of the skeleton soon enabled Owen to publish a satisfactory account of the animal, which he named *Diprotodon* ("two-front-teeth") in allusion to the rabbit-like or wombat-like arrangement of the anterior cutting teeth (incisors). The original specimens from the river deposits of Queensland, many collected by Dr. George Bennett, are arranged in Wall-case 27 and Table-case 15, with the remains of an allied smaller animal, *Nototherium*, from the same region. There is also a reconstructed skeleton, partly made of original limb-bones from the dry salt plain bordering Lake Eyre, in South Australia. Notwithstanding its great size, the general shape of *Diprotodon* must have been much like that of the existing phalangers of Australia, and it seems to be related both to these animals and to the kangaroos.

Table-case
14b.

Wall-case
27.
Table-cases
14, 14a, 15.

Wall-case 27. The skull (Fig. 72) measures about three feet in length. The grinding teeth are ridged, much like those of a primitive elephant, such as *Dinotherium*. The toes are five in number but remarkably short and slender.

Table-cases 14, 14a, 15. The remains of **kangaroos** from the river deposits of Queensland and New South Wales, and from the Wellington Caves, New South Wales, indicate animals of various sizes from that of the smallest living species to that of a donkey. The unique original collection described by Owen is exhibited in Table-cases 14, 15. The largest extinct species referred to *Procoptodon* and *Palorchestes*, though essentially kangaroos, had the fore and hind limbs less disproportionate



FIG. 72.—Skull and lower jaw of a gigantic extinct Marsupial, *Diprotodon australis*, from the Pleistocene of Queensland; with a Human Skull (B) to show comparative size. (Wall-case 27.)

in size than any living member of the family, and would probably be unable to leap.

Table-case 14a. The largest of the extinct **wombats**, found with *Diprotodon* and the large kangaroos, is *Phascogonus*, of which the lower jaw and upper front teeth are shown in Table-case 14a. It was about as large as an ox. Here are also numerous remains of wombats of more ordinary size.

Table-case 14. The **phalangers** seem to be represented among fossils by the so-called "pouched lion" of Owen, *Thylacoleo carnifex*, which is also found with *Diprotodon* and the large kangaroos in the Australian river deposits and caverns. Numerous unique fragments are exhibited, with a restored model of the

skull and mandible (Fig. 73), in Table-case 14. This animal was regarded by Owen as having preyed upon the large Australian herbivores in the same way that the lion feeds at present on the antelopes and other herbivores in Africa. The lion-like shape of the head and jaws, with the great cutting tooth followed behind by little crushing teeth, seemed to Owen to justify this conclusion. Other naturalists, however, have doubted whether *Thylacoleo* fed on flesh, or at least was more than a mixed feeder, because its large front teeth are incisors, and no known existing carnivore has canine teeth too small for grasping. Table-case
14.

The undoubted carnivorous marsupials contemporary with the extinct animals just enumerated, were identical with those still surviving in Tasmania. They are species

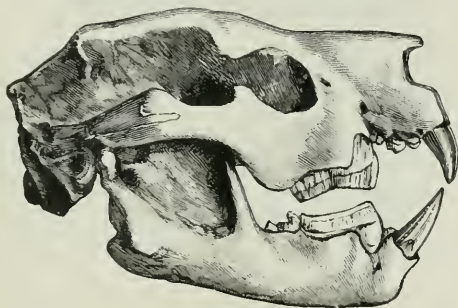


FIG. 73.—Skull and lower jaw of *Thylacoleo carnifex*, from the Pleistocene of Australia; one-fifth nat. size. (Table-case 14.)

of the “Tasmanian Wolf” (*Thylacinus*) and the “Tasmanian Devil” (*Sarcophilus*), of which jaws are exhibited in Table-case 14.

Unfortunately, no satisfactory remains of mammals are known from rocks below the Pleistocene in the Australian region; and the exact connection between the pouched animals of Australia and the mammals of other parts of the world has not yet been revealed by fossils. It is, however, interesting to notice that the Tasmanian *Thylacinus* and *Sarcophilus* just mentioned are essentially similar to the Creodonta, which flourished in the northern hemisphere at the beginning of the Tertiary period (see p. 16), and to the Sparassodonta, which survived until still later times in South America (see p. 17). It is also worthy of remark that the small pouched opossums, now confined to the American

Table-case
14a.

tropics, lived with the Creodonta both in Europe and North America, while other undoubted little pouched animals, such as *Epanorthus*, accompanied the Sparassodonta and early opossums in South America. Jaws of these small marsupials, some from the Lower and Upper Eocene of England, and from the Lower Miocene of France, are shown in Table-case 14A. A few South American jaws are arranged with them.

From these and other considerations it seems likely that

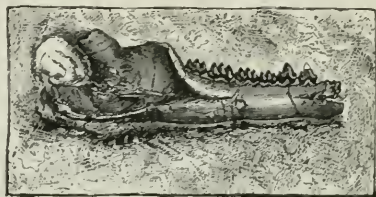


FIG. 74.—Lower jaw and teeth of *Triconodon mordax*, from the Purbeck Beds of Swanage; nat. size. (Table-case 14A.)

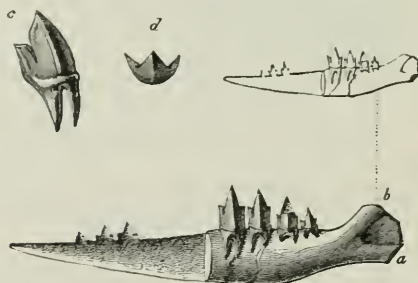


FIG. 75.—Part of lower jaw and teeth of *Spalacotherium tricuspideus*, from the Purbeck Beds of Swanage; outline-fig. nat. size, *c* and *d* being lateral and upper views of a molar tooth. (Table-case 14A.)

the Australian region has remained isolated from the rest of the world since the end of the Secondary epoch, and that its marsupials are the slightly altered survivors of the mammal-life then characteristic of every continent.

Table-case
14a.

The only known mammals of the Secondary or Mesozoic epoch are creatures about as large as rats, whose jaws and limb-bones have been found in the Upper Cretaceous and Jurassic rocks of North America, and in the Jurassic (Purbeck Beds and Stonesfield Slate) of England. Most of them seem to have been insectivorous marsupials, and one

jaw of a young *Triconodon* from the Purbeck Beds of Swanage is believed to show a single tooth being replaced in the typical marsupial fashion (see p. 17). The unique collection from the Purbeck Beds, made by Mr. S. H. Beckles, is arranged in Table-case 14A, and comprises several jaws of *Triconodon* (Fig. 74) and *Spalacotherium* (Fig. 75), besides remains of other genera described by Owen in his "Monograph of Mesozoic Mammals" (Palæont. Soc., 1871). With these are some jaws from the Stonesfield Slate including the original specimen of *Phascolotherium bucklandi* (Fig. 76),

Table-case
14a.

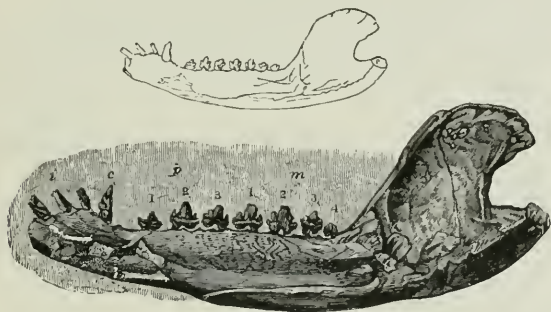


FIG. 76.—Lower jaw and teeth of *Phascolotherium bucklandi*, from the Stonesfield Slate of Oxfordshire; outline-fig. nat. size. (Table-case 14A.)

which was so much discussed by Cuvier, Agassiz, and others early in the last century. Drawings of the American Mesozoic jaws are placed with this collection for reference (Fig. 77).

SUB-CLASS III.—PROTOTHERIA.

ORDER XI.—MULTITUBERCULATA.

In some of the jaws of Mesozoic mammals, and in a few similar specimens from the base of the Eocene, both in Europe and North America, there are crushing teeth which bear two or three rows of tubercles or are provided with tubercles round the edge. The otherwise unknown animals to which these jaws belong are named Multituberculata, and they are supposed to be related to the ancestors of the living egg-laying mammals (Monotremata) of the Australian region, because the young *Ornithorhynchus* has somewhat similar multituberculate teeth (see Fig. 82, p. 85).

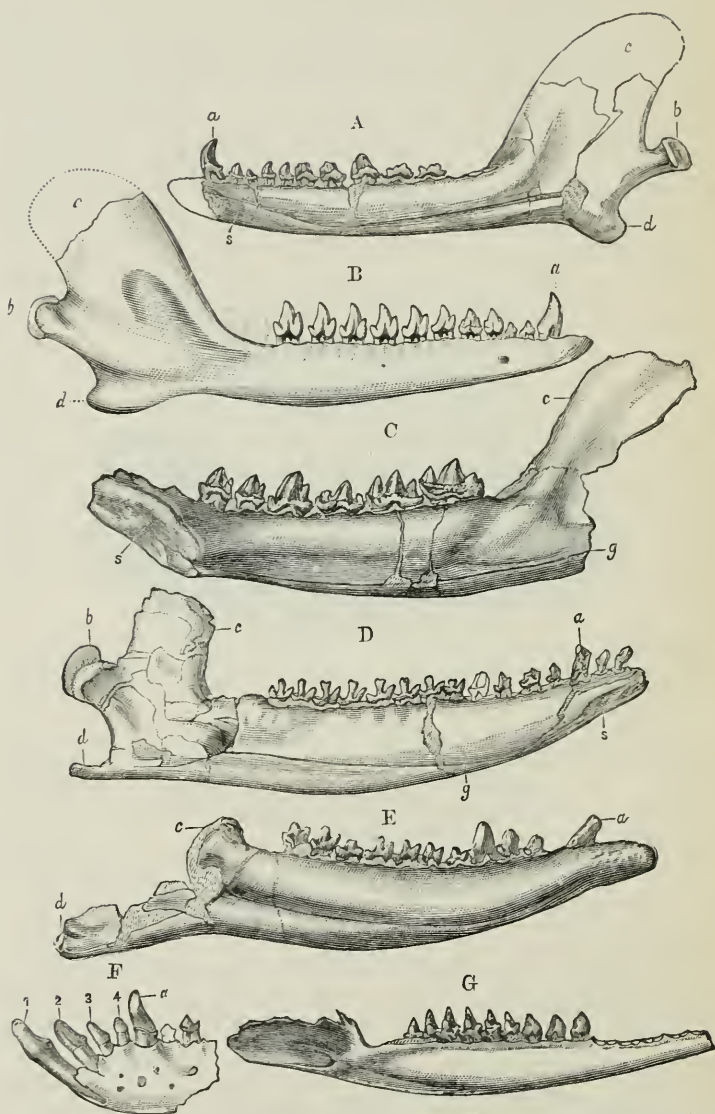


FIG. 77.—Lower jaws of American Jurassic Mammals, from Wyoming, U.S.A.; A, B, twice nat. size; C-F, thrice nat. size; G, four times nat. size. Named by O. C. Marsh as follows:—A. *Docodon striatus*; B. *Dicrocynodon victor*; c. *Priacodon ferox*; d. *Dryolestes priscus*; E. *Dryolestes vorax*; F. *Asthenodon segnis*; G. *Laodon venustus*. a, canine; b, condyle; c, coronoid process; d, angle; g, mylohyoid groove; s, symphyseal surface.

The largest of these mammals are represented in the Lower Eocene of New Mexico, U.S.A., by jaws which are named *Polymastodon* in allusion to their "teeth with many nipples." One piece of jaw and two plaster casts of complete jaws are exhibited in Table-case 14A. A much smaller Multituberculata, *Ptilodus*, occurs with *Polymastodon* in New Mexico, while the allied *Neoplagiaulax* (Fig. 78) is found in the Lower Eocene of Rheims, France; but there are no



FIG. 78.—Upper molar tooth of *Neoplagiaulax eocenus*, grinding surface and two lateral aspects, from the Lower Eocene of Rheims, France; the lower line indicating nat. size. (After Lemoine.)

specimens of these in the collection. Nearly similar teeth and jaws are met with in the Upper Cretaceous Laramie Formation of North America; and others, of the genus *Plagiaulax*, of which several jaws are shown in the Beekes Collection from the Purbeck Beds, have cutting teeth in front and multituberculate teeth only behind (Fig. 79).

Two-rooted multituberculate teeth, belonging to an unknown animal named *Microlestes*, are found even in the

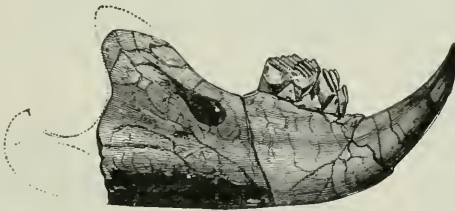


FIG. 79.—Lower jaw and cutting teeth of *Plagiaulax beekesi*, from the Purbeck Beds of Swanage; twice nat. size. (Table-case 14A.)

Rhætic Formation of England and Würtemberg. Specimens of the very small *M. moorei* are exhibited from a Rhætic fissure-deposit at Holwell, near Frome. They bear tubercles round the edge of the crown and closely resemble the hinder teeth of *Plagiaulax*. A skull with multituberculate teeth from the Upper Triassic Karoo Formation of South Africa was also placed here for some time. This (Fig. 81) was described under the name of *Tritylodon longærus* and assigned to a mammal by Owen; while a fore limb from the same formation, named *Theriodonmus phylarchus* by Seeley,

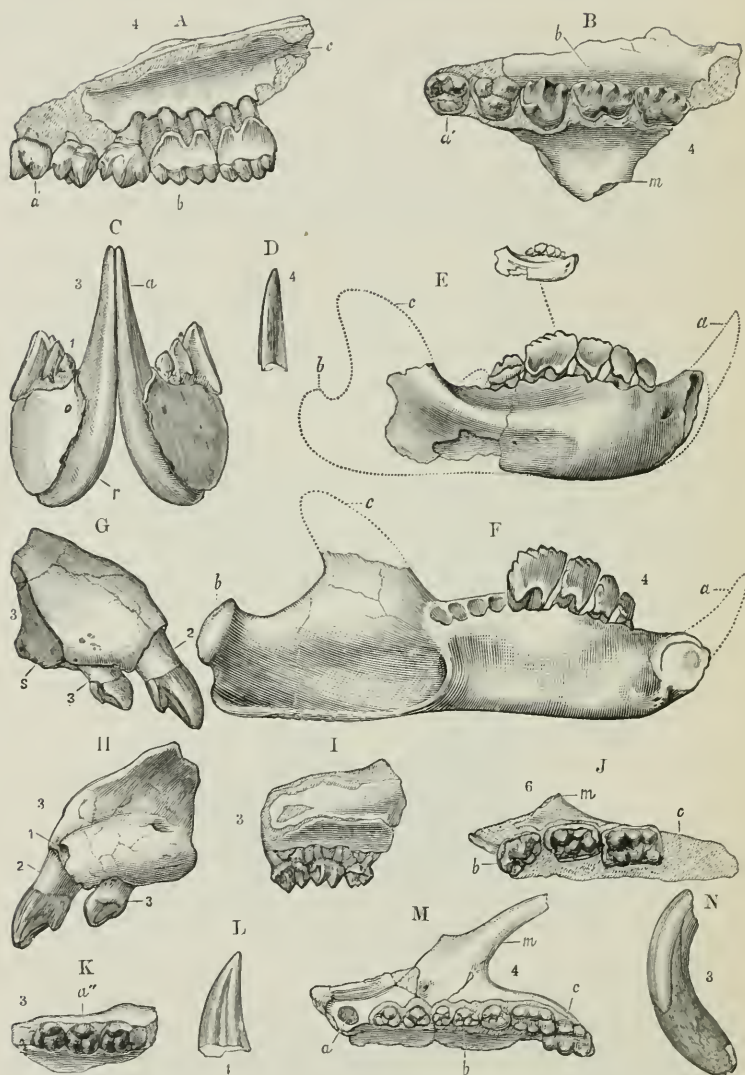


FIG. 80.—Upper and lower jaws of American Jurassic Multituberculata, from Wyoming, U.S.A.; three to six times nat. size, as marked. Named by O. C. Marsh as follows:—A-C. *Ctenacodon potens*; E, F. *Ctenacodon serratus*; G, H, I, K, N. *Allodon fortis*; J. m. *Allodon laticeps*; D, L. incisors of *Ctenacodon*. In upper jaws:—1, 2, 3, incisors; a', first premolar; a'', second premolar; b, fourth premolar; b', third premolar; c, second true molar; m, malar arch; s, suture with maxilla. In lower jaws:—a, incisor; b, condyle; c, coronoid process; r, root of incisor.

may perhaps belong to a similar animal. In the Triassic period, however, the Theriodont Reptiles so closely approached

Table-case
14a.

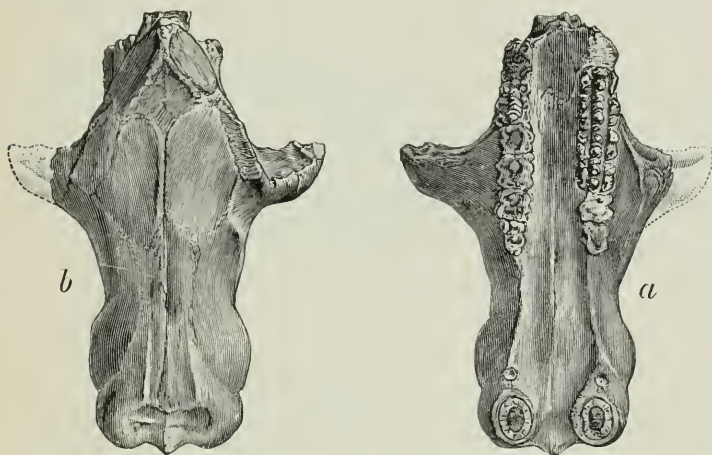


FIG. 81.—Skull of *Tritylodon longævus*, palatal view (a) and upper view (b), incomplete behind, from the Karoo Formation (Trias) of Basutoland, South Africa; two-thirds nat. size. (Gallery of Fossil Reptiles, Table-case 32.)

the lowest mammals that skeletons alone hardly suffice for the exact determination of their affinities.

Tritylodon and *Theriodesmus* are now arranged with the Theriodonts in the Gallery of Fossil Reptiles (Table-case 32).

ORDER XII.—MONOTREMATA.

The existing monotremes of the Australian region are evidently the much-altered survivors of a very ancient race, and owe their escape from extinction to their small size and burrowing habits. Their predecessors, however, are almost unknown. Plaster casts of some limb-bones of a large *Echidna* from the Wellington Caves, New South Wales, are exhibited in Table-case 14A.

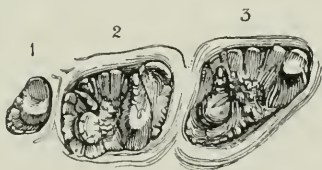


FIG. 82.—Right lower molar teeth of the existing Australian Monotreme (*Ornithorhynchus*), showing their multituberculate crown; three times nat. size. (After C. Stewart.)

GALLERY NO. 2—FOSSIL BIRDS.

Remains of birds are very rare among fossils, except in comparatively modern deposits on land; and even under these circumstances they are usually quite fragmentary. They occur most commonly in swamps, such as the English Fenland; in the bed of silted-up lakes; and in caverns and fissures. They are only found by rare accident in the marine deposits of an earlier geological date.

CLASS.—AVES.

ORDER I.—CARINATÆ.

Table-case
13.

The English Prehistoric and Pleistocene birds, so far as known from the local deposits just mentioned, were essentially similar to those which have lived in this country during historic times. Of special interest, however, is the discovery of remains of the pelican in the Fenland, and in refuse heaps on the site of an ancient British village near Glastonbury. It is also worthy of note that the great auk or gare fowl (*Alca impennis*), which became extinct in 1844, has been found in deposits in the north of England, Scotland, and Ireland; and a complete skeleton of this bird, discovered by Professor John Milne in a guano deposit on Funk Island, off Newfoundland, is exhibited in a special Case marked KK, near the S.E. window.

Among older remains of European flying birds exhibited in Table-case 13, may be noted a leg-bone of an albatross (*Diomedea*) from the Red Crag of Suffolk; bones of flamingo-like birds (*Palæolodus*, *Phœnicopterus*), a species of ibis, ducks and other birds from the Miocene of France; and various eggs and feathers in Miocene freshwater limestones and lignite from France and Germany.

Still older is the unique collection of remains of Lower Eocene birds from the London Clay exhibited in the same Table-case. These fossils chiefly represent fish-eating sea-birds, among which *Odontopteryx* and *Prophaethon* are especially noteworthy. The skull of *Odontopteryx* (Fig. 83) is remarkable for its strongly serrated jaws, the little pointed

processes of bone being doubtless originally covered by similar elevations of the horny beak, which would act like teeth in dealing with the slippery prey. This bird was

Table-case
13.

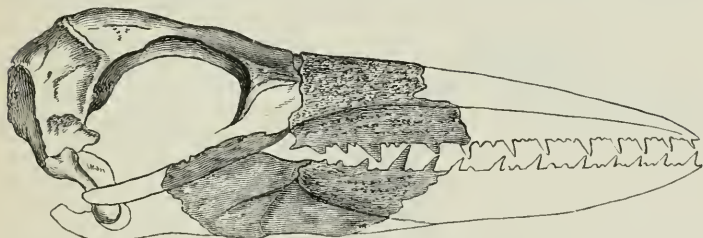


FIG. 83.—Skull and lower jaw of *Odontopteryx toliapica*, with bony denticles on jaws, from the London Clay of Sheppey; two-thirds nat. size. (Table-case 13.)

probably related to the living gannets. *Prophaethon* resembles a modern tropic bird, but has relatively larger hind legs. Like the other fossils of the London Clay, these birds indicate a subtropical climate in the south of England at the time when they lived here.

From the London Clay there is also part of a large skull named *Dasornis londiniensis* by Owen, who thought it might perhaps belong to a Ratite bird like the ostrich. More satisfactory remains of a large running bird, *Gastornis*, from the Lower Eocene of England, France, and Belgium, suggest affinities with the geese rather than with the ostriches.

The earliest of all true and typical birds hitherto discovered, are represented in Table-case 13 by a few bones of *Enaliornis* from the Cambridge Greensand (Upper Cretaceous) and by vertebræ, a pelvis, and limb-bones, with plaster casts of other bones, of *Hesperornis* from the Chalk of Kansas, U.S.A. The vertebræ with saddle-shaped ends are especially well preserved. These fossils seem to belong to swimming birds like the existing divers (*Colymbus*); and the larger bones from Kansas indicate a species *H. regalis* (Fig. 84), which would measure from three to four feet in height. A large drawing of a skeleton restored by the discoverer, Professor O. C. Marsh, is framed near the window. *Hesperornis* has teeth in a groove in each jaw, though the extremity of its upper jaw is toothless, and would probably be covered with the usual horny beak. The bird must have been flightless, as indicated by its flattened breast-bone (sternum). A

Table-case 13. little flying bird with keeled sternum, *Ichthyornis* (Fig. 85), has also been found in the Kansas Chalk, but is not represented in the collection. Its teeth are in distinct sockets, and some of its vertebrae are biconcave.



FIG. 84.—Skeleton of a toothed flightless bird, *Hesperornis regalis*, from the Cretaceous of Kansas, U.S.A.; about one-eighth nat. size. (After Marsh. See Table-case 13.)

Table-case. 13a. Among quite recently exterminated Carinatae from the southern hemisphere, the rails from New Zealand (*Aptornis*),
Case BB.

the Chatham Islands (*Diaphorapteryx*) and Mauritius (*Aphanapteryx*), are of great interest on account of their close resemblance to each other and to the living weka rail (*Ocydromus*) of New Zealand. As they are all unable to fly,

Table-case
13a.
Case BB

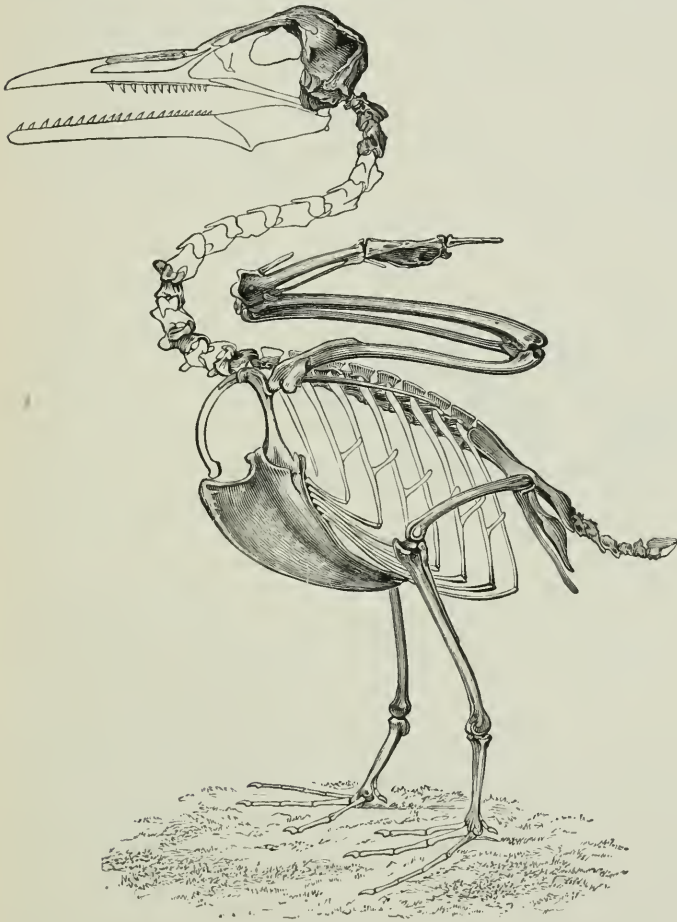


FIG. 85.—Skeleton of a toothed flying bird, *Ichthyornis victor*, from the Cretaceous of Kansas, U.S.A.; one-half nat. size. (After Marsh.)

it is difficult to understand how they reached such widely separated islands. They are illustrated by various specimens

Table-case 13a. in Table-case 13A, and by complete skeletons of *Aptornis* and *Diaphorapteryx* in a special Case marked BB.

Case BB. With these rails there also lived flightless geese and coots on the islands of the southern Ocean. An incomplete skeleton of the large flightless goose (*Cnemidornis calceitans*) from New Zealand is mounted in Case JJ; and there is a reconstructed skeleton of a coot (*Palæolimnas chathamensis*) from the Chatham Islands in Wall-case 25.

Case JJ. Other remains of the same birds and their allied genera are arranged in Table-case 13A. They and the smaller kinds of moas in New Zealand were probably the food of a large and powerful bird of prey (*Harpagornis moorei*), of which the greater part of a skeleton is mounted in Case LL.

Case LL.

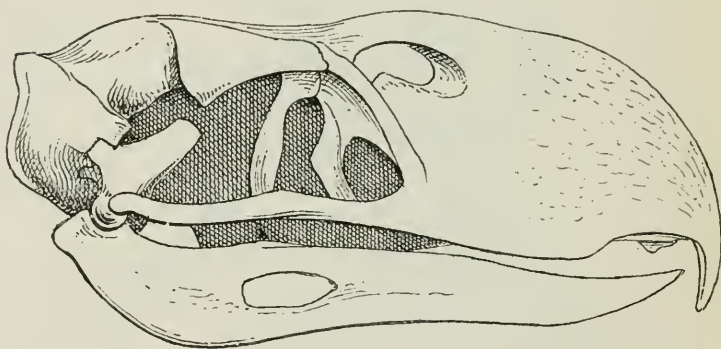


FIG. 86.—Restored skull and lower jaw of *Phororhachos longissimus*, from the Santa Cruz Formation of Patagonia; one-sixth nat. size. (Case AA.)

Wall-case 25. A reconstructed skeleton, with plaster casts of the head and foot, of the extinct dodo (*Didus ineptus*) or flightless ground-pigeon of Mauritius, is exhibited in Case CC, and there are other bones in Wall-case 25. This bird, however, is better illustrated in the Department of Zoology, where there is also a skeleton of the allied solitaire (*Pezophaps*) from Rodriguez.

Table-case 12a. To a somewhat earlier geological period must be assigned the extinct cariamas and other birds from the Santa Cruz and other Tertiary Formations of Patagonia, which are comprised in the Ameghino Collection in Table-case 12A. *Phororhachos*, the best known genus, is characterised by a very large head and a small body, as shown by the associated

Case AA.

parts of a single individual here exhibited. One of the largest species, *Phororhachos longissimus*, is represented by a nearly complete lower jaw and the sharp tip of the upper jaw, which are enough to justify the model of a restored skull and mandible of this bird mounted in an adjacent special Case (AA). The model (Fig. 86) measures nearly two feet in length, and is much larger than the head of any other known bird. The use of the powerful hooked beak is unknown.

Table-case
12a.
Case AA.

ORDER II.—**RATITÆ.**

The ostrich-like flightless birds were much more numerous and more widely distributed in the Pleistocene period than they are at the present day. They were especially characteristic of the southern hemisphere, and some of them attained a gigantic size.

Wall-cases
23-25.
Table-case
12.

These birds were most numerous represented in New Zealand, where they survived until the arrival of the Maories, and may even have existed in some places at the time of Captain Cook's visit in 1777. They are referred to in many native legends under the name of "Moa," but they remained unknown to science until 1839, when the shaft of a small thigh-bone, now exhibited in Table-case 12, was described by Owen. He recognised that this bone belonged to a flightless bird of a heavier and more sluggish kind than the ostrich, which he proposed to name *Dinornis struthioides* ("terrible bird like an ostrich"). By the exertions of the Hon. Walter Mantell and numerous later explorers a wonderful series of *Dinornithidæ* of many genera, species, and varieties has gradually been discovered, and these birds are now well represented in the collection. Of the largest species, *Dinornis maximus*, there is a nearly complete skeleton of one individual 8 ft. 6 in. in height in Case GG (see Plate V). With this is placed another complete skeleton of one of the smallest species, *Anomalopteryx parva*, only three feet in height. There is also a stuffed specimen of a kiwi (*Apteryx*), which is the sole survivor of the Ratitæ in New Zealand at the present day. In boxes on the floor of the case are some of the bony rings of the windpipe found with the fossil skeletons. The skeleton of a medium-sized bird with very stout legs, *Pachyornis elephantopus*, is mounted in Case FF, and in front of this there is a small slab of sandstone from a hardened beach bearing the footprint of one of the moas. Skeletons of two more slender small species,

Case GG.

Case FF.

Case HH. *Anomulopteryx didiformis* and *Emeus gravipes*, are exhibited in Case HH. There are also various more fragmentary specimens of Dinornithidæ in Wall-cases 23 and 24 and in Table-case 12. In the latter may be noticed, besides eggs and feathers, the mummified remains of the head, neck and legs of a small species from a very dry fissure-cavern in Otago. This specimen shows, in addition to the skin, the bony (sclerotic) plates round the eye, the tracheal rings of the windpipe, and the sheath of the claws. Many of the more fragmentary bones were obtained from the old cooking-places of the Maories, who seemed to have hunted and fed upon the moas.

Case GG. As shown by the fine skeleton of *Dinornis maximus* (Plate V), the wing is more reduced in the Dinornithidæ than in any other known birds. There is nothing beyond a small scapulo-coracoid bone, which does not even bear a socket for the limb. The feathers agree much more closely with those of the Australian emus and cassowaries than with those of the New Zealand kiwis.

In the Australian region there were emus in the Pleistocene period. There was also another large Ratite bird, *Genyornis newtoni*, of which remains have been discovered near lake Callabonna, South Australia. As shown by a hind limb in Wall-case 24, it had a remarkably slender inner toe. It lived with the small-toed *Diprotodon* already mentioned (p. 78).

Ratite birds were also abundant in Madagascar at a quite recent geological period, although none now survive in that island. They seem to have been most closely similar to the *Apteryx* and moas of New Zealand, and one species, *Aepyornis titan*, of which there are limb-bones in Wall-case 25 and a plaster cast of a limb on Stand II, probably exceeded in size the largest of the New Zealand birds. A specimen of moderate dimensions, *Aepyornis hildebrandti*, is represented in Case DD by a reconstructed skeleton, which exhibits a short and broad breastbone, like that of *Apteryx*, with remains of a very small wing. Eggs of *Aepyornis* are not uncommon in the sand bordering the lakes of Madagascar, and they are sometimes washed out during stormy weather. Under these circumstances they float on the water and are picked up by the natives. Fine examples are shown in Case DD. The largest measures three feet in its largest circumference by two feet six inches in girth, and its liquid contents would equal a little more than two gallons. Such eggs would probably be laid by the largest



Skeleton of the Gigantic Moa (*Dinornis maximus*) from New Zealand;
one-seventeenth nat. size. (Case GG.)

species, *Aepyornis titan* and *A. maximus*, but it is worthy of note that in the New Zealand *Apteryx* the egg is enormous compared with the size of the bird which lays it (see Case GG).

Wall-case
25.
Case GG.

The living rheas of South America were preceded in the Tertiary period by large birds like *Brontornis*, of which plaster casts of limb-bones are exhibited in Wall-case 25. The two-toed ostriches, which are now confined to Africa and Arabia, ranged into the Indian and south-eastern European regions in Pliocene times. Remains of *Struthio asiaticus* from the Siwalik Formation of India are placed with the skeleton of a modern ostrich in Case EE. A small piece of limb-bone from the Eocene of the Fayum, Egypt, exhibited in Table-case 12, probably represents an ancestor of the ostriches, which has been named *Eremopezus eocaenus*.

Wall-case
25.

Case EE.

ORDER III.—SAURURÆ.

Birds are proved by their structure to be closely related to reptiles; and many of the extinct reptiles exhibit peculiarities which are now exclusively confined to birds. It is therefore interesting to observe that the oldest known birds, which date back to the latter part of the Jurassic period, approach the reptiles more nearly than any existing birds in at least four respects. They are peculiar in (1) the possession of true teeth, (2) the biconcave or flat-ended shape of their vertebræ, (3) the completeness of three clawed fingers in the wing, and (4) the elongated, not tufted, shape of the tail. In allusion to the last-mentioned feature they are named Saururæ ("lizard-tails").

Table-case
13.

Of these primitive birds only two satisfactory specimens have hitherto been discovered, both in the Lithographic Stone of Bavaria, which is of the same geological age as the Kimmeridge Clay of England. They seem to belong to two species of one genus, and the first specimen, representing *Archæopteryx macrura* of Owen, is shown in Table-case 13. The piece of limestone in which the skeleton is preserved has split along the plane of weakness caused by the presence of the fossil itself, so that some of the bones adhere to one face while other portions are retained by the counterpart slab. It is thus necessary to exhibit the two slabs side by side, the one supplementing the other. As shown by the accompanying photograph (Plate VI) and the explanatory diagram (Fig. 87), there is a typical bird's "merrythought" (furcula)



FIG. 87.—Diagrammatic sketch of the fossil lizard-tailed bird, *Archæopteryx macrura*, from the Lithographic Stone (Upper Jurassic) of Eichstädt, Bavaria; about one-quarter nat. size. *a*, acetabulum; *b*, cast of brain-cavity of skull; *c*, ribs; *cr*, carpals; *f*, femur; *fu*, furcula; *h*, humerus; *i*, ischium; *mt*, tarsometatarsus; *p*, phalanges of foot; *r*, radius; *sc*, scapula; *t*, tibia; *u*, ulna; 1, 2, phalanges of hand. (Table-case 13.)



Fossil Lizard-tailed Bird, *Archæopteryx macrura*, from the Lithographic Stone (Upper Jurassic) of Eichstätt, Bavaria; about one-quarter nat. size. (Table-case 13.)

[To face p. 94.

between the wings ; and the hind leg is exactly that of a perching bird. The long tail, however, comprises a row of twenty slender vertebrae, each bearing a pair of feathers. Owing to the fine grain of the stone, the feathers both of the wings and the tail are perfectly displayed in impressions, which were made when the actual feathers were originally buried in the soft limy mud.

Of the second specimen of the *Archæopteryx*, now in the Berlin Museum, a plaster cast is placed next to the first example in Table-case 13. It retains the head, which is quite bird-shaped, though its jaws are provided with teeth

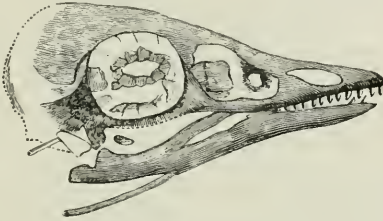


FIG. 88.—Skull and lower jaw of *Archæopteryx siemensi*, showing teeth, from the Lithographic Stone (Upper Jurassic) of Eichstätt, Bavaria ; nat. size. (After Dames. Original in Berlin Museum. Plaster cast in Table-case 13.)

in sockets (Fig. 88). It also exhibits the three clawed fingers of the wing. A photograph of the specimen is fixed head downwards on the wall near the window, to show the lizard-like sprawl assumed by the skeleton at the time it was buried.

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